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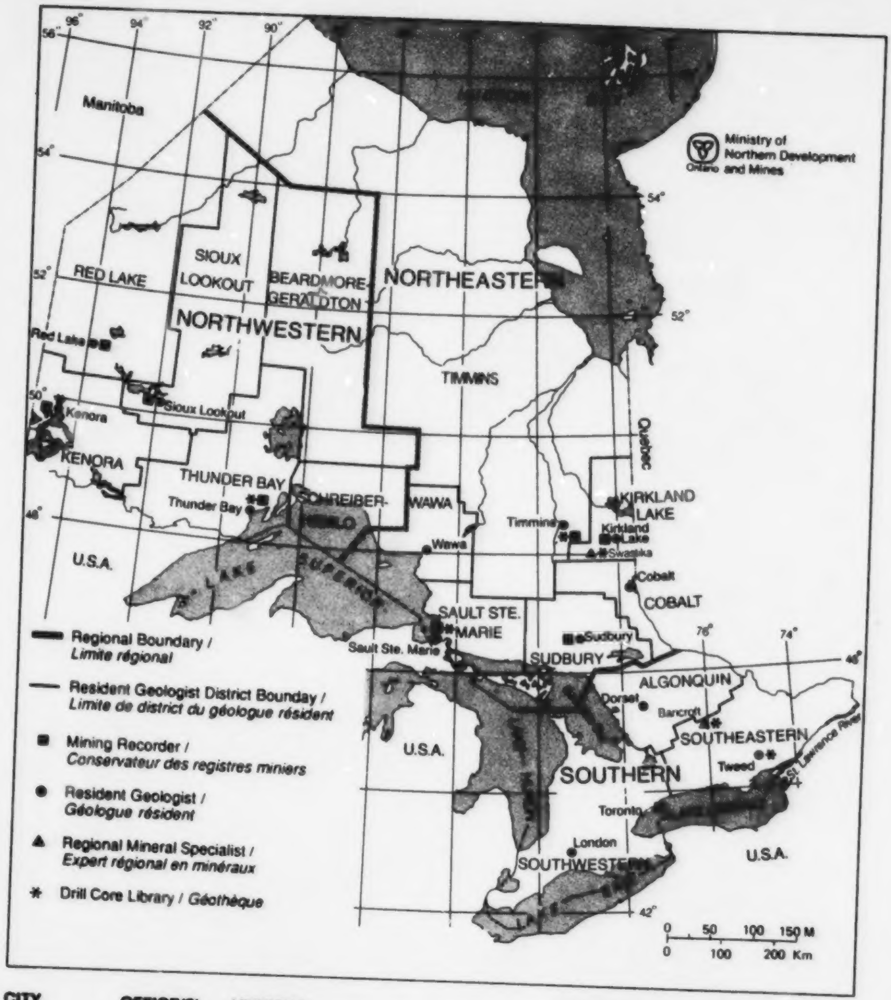
Ministry of Northern Development and Mines
Ontario
Manitoba
RED LAKE
SIOUX LOOKOUT
BEARDMORE-GERALDTON
NORTHWESTERN
NORTHEASTERN
TIMMINS
Red Lake
Sioux Lookout
Kenora
KENORA
THUNDER BAY
Thunder Bay
SCHREIBER-HEMLO
WAWA
Wawa
Timmins
KIRKLAND LAKE
Kirkland Lake
Swastika
Cobalt
COBALT
Quebec
U.S.A.
LAKE SUPERIOR
SAULT STE. MARIE
Sault Ste. Marie
Sudbury
SUDBURY
ALGONQUIN
Dorset
Bancroft
SOUTHEASTERN
Tweed
St. Lawrence River
SOUTHERN
Toronto
London
SOUTHWESTERN
96°
94°
92°
90°
56°
54°
52°
50°
48°
46°
42°
76°
74°
0 50 100 150 M
0 100 200 Km
Regional Boundary / Limite régional
Resident Geologist District Bounday / Limite de district du géologue résident
■ Mining Recorder / Conservateur des registres miniers
● Resident Geologist / Géologue résident
▲ Regional Mineral Specialist / Expert régional en minéraux
* Drill Core Library / Géothèque

CITY *VILLE*	OFFICE(S) *BUREAU(X)*	ADDRESS *ADRESSE*	TELEPHONE *TÉLÉPHONE*	FAX *TÉLÉCOPIEUR*
Kenora	●	Box 5200, 808 Robertson St. P9N 3X9	(807) 468-2813	(807) 468-2823
	■	Box 5200, 808 Robertson St. P9N 3X9	(807) 468-2815	(807) 468-2823
	*	860 Fourth Ave. S. P9N 2A1	(807) 468-3658	—
Red Lake	●	Box 324, Ont. Govt. Bldg. P0V 2M0	(807) 727-3272	(807) 727-3553
	■	Box 324, Ont. Govt. Bldg. P0V 2M0	(807) 727-3284	(870) 727-3553
Sioux Lookout	●	Box 3000, OPP Bldg. P0V 2T0	(807) 737-2039	(807) 737-1727
	■	Box 3000, OPP Bldg. P0V 2T0	(807) 737-2034	(807) 737-1727
Thunder Bay	● (3)	Box 5000, 435 James St. S. P7C 5G6	(807) 475-1331	(807) 475-1112
	■	Box 5000, 435 James St. S. P7C 5G6	(807) 475-1311	(807) 475-1124
	*	335 Euclid Ave. P7E 6G6	(807) 475-1333	—
Wawa	●	Box 530, Helen Mine Rd. P0S 1K0	(705) 856-4883	(705) 856-4282
Sault Ste. Marie	●	60 Church St. P6A 3H3	(705) 949-1231	(705) 949-8571
	■	60 Church St. P6A 3H3	(705) 949-1231	(705) 949-0014
	*	64 Church St. P6A 3H3	(705) 949-1231	—
Timmins	●	60 Wilson Ave. P4N 2S7	(705) 360-8350	(705) 264-8723
	■	60 Wilson Ave. P4N 2S7	(705) 360-8330	(705) 264-8723
	*	896 Riverside Dr. P4N 3W2	(705) 360-8370	—
Kirkland Lake	●	4 Government Rd. E. P2N 1A2	(705) 567-5242	(705) 567-5621
	■	4 Government Rd. E. P2N 1A2	(705) 567-9241	(705) 567-5621
Swastika	▲ *	Box 129, P0K 1T0	(705) 642-3222	(705) 567-5621
Cobalt	●	Box 230, Presley St. P0J 1C0	(705) 679-8558	(705) 679-5584
Sudbury	●	2nd floor, 159 Cedar St. P3E 6A5	(705) 670-7325	(705) 670-7323
	■	2nd floor, 159 Cedar St. P3E 6A5	(705) 670-7321	(705) 670-7323
Dorset	●	Box 190 P0A 1E0	(705) 766-2494	(705) 766-9976
Tweed	● *	B.S. 43, Old Troy Rd. K0K 3J0	(613) 478-3161	(613) 478-2873
Bancroft	▲ *	Box 3000, Highway 28 S. K0L 1C0	(613) 332-4875	(613) 332-1800
Toronto	■	1st floor, 10 Wellesley St. E. M4Y 1G2	(416) 965-1322	(416) 963-0257
London	●	Box 5463, 659 Exeter Rd. N6A 4L6	(519) 661-2773	(519) 661-2819

1. Field Services Section, Northwestern Ontario Introduction

K.G. Fenwick

Manager, Field Services Section (Northwest), Ontario Geological Survey – Information Services Branch

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The Field Services Section, northwestern Ontario, of the Mines and Minerals Division is made up of 6 Resident Geologists' districts and covers 4 Mining Divisions: the Thunder Bay, Red Lake, Patricia and Kenora mining divisions. This area is approximately 700 by 700 km in size.

The goal of the Field Services Section is to stimulate and monitor exploration, development and production of the mineral resources in northwestern Ontario. This is done through the 6 Resident Geologists' programs which cover the Red Lake, Sioux Lookout, Kenora, Thunder Bay, Beardmore–Geraldton and Schreiber–Hemlo Resident Geologists' districts; the Canada–Ontario 1991 Northern Development Agreement (NODA) which funded the Northwestern Ontario Industrial Minerals project and the Manitouwadge Mineral Occurrence Inventory project; the 1990–91 Employment Equity Fund which provided funding for an inventory of the amethyst occurrences in the Thunder Bay area; and the Drill Core Library program which comprises 2 libraries—one in Kenora and the other in Thunder Bay.

The Resident Geologists' programs provide a professional consultative service and advice both in the office and in the field. These services are made available to prospectors, exploration companies and the public on matters related to the geology, the mineral deposits and the exploration and mining activities conducted in northwestern Ontario. In 1991, over 9000 office and phone consultations were provided to their clientele. The Mines and Minerals Division staff made over 260 field visits to exploration and mining sites. The Resident Geologists' general duties also included the provision of technical information and recommendations to other government agencies (i.e., Ontario Ministry of Natural Resources, Ontario Ministry of The Environment, Ontario Ministry of Labour) on land-use matters.

Basic prospecting courses were conducted in Nipigon, Fort Frances, Savant Lake, Atikokan, Upsala and Thunder Bay. Prospectors' workshops were held in Marathon, Manitouwadge and Schreiber. Posters depicting the exploration and mining activities in the 6 Resident Geologists' districts and the Industrial Minerals in northwestern Ontario were put on display at the 2 Mines and Minerals Symposia in Toronto and Thunder Bay. A corporate poster, depicting the exploration and mining activities in northwestern Ontario, was presented at the Institute on Lake Superior Geology Annual Meeting in Eau Claire, Wisconsin, at the 1991 State of Minnesota Mineral Activities Symposium in Chisholm, Minnesota, and at the Northeastern Ontario Mines and Minerals Symposium in Kirkland Lake.

Reports were either started or continued on both research into and field visits to the mineral occurrences in the Birch–Confederation lakes area, the Fort Hope–Miminiska Lake area, the Sturgeon Lake area, the Onaman–Tashota area and the Central Uchi metavolcanic belt. Satellite summertime field offices were maintained in Beardmore, Geraldton and Marathon.

The staff of the Thunder Bay Drill Core Library collected 6158 m of diamond-drill core form 8 prospects in the Thunder Bay Mining Division during 1991. The staff from the Kenora Drill Core Library collected, from November 20, 1990, to December 31, 1991, 5024.7 m of drill core. Much of the drill core in this library is from recent gold exploration.

Exploration activity in northwestern Ontario in 1991 was approximately at 75% of the level of activity recorded in 1990. The decline is the result of a reduced number of active junior- mining companies. Gold exploration accounted for more than 80% of this exploration activity. In all, there were over 300 active exploration programs in the region in 1991. Over 50% of these active exploration programs were funded by the Ontario Prospectors Assistance Program (OPAP). Of these, 3 were in the advanced-exploration stage.

In 1991, 59 exploration projects in northwestern Ontario were designated under the Ontario Mineral Incentive Program (OMIP) for an approximate total of $2.9 million. One hundred and sixty-nine projects were approved under the Ontario Prospectors Assistance Program for an approximate total of $1.6 million.

It has been another excellent year for production of gold in northwestern Ontario. The combined production from the 7 operations—the Golden Giant, the David Bell, the Williams, the Golden Patricia, the Campbell Red Lake, the Arthur W. White and the Dona Lake mines—was over 1.6 million ounces of gold. This amount represents two thirds of Ontario's—and one third of the nation's—gold production.

Four base metal mines—the Lyon Lake, the Winston Lake, the Geco and the Shebandowan—were in production during the year. Operations at the Lyon Lake Mine, owned by Noranda Inc., were suspended on May 22, 1991.

Two pink-granite dimension-stone quarries were in production. Active mining at 10 amethyst deposits, northeast of Thunder Bay, continued on a seasonal basis. Two railway-ballast quarries were in operation from April to September in northwestern Ontario. Other industrial minerals produced in the area include white quartz, soapstone and diabase.

2. Kenora Resident Geologist's District—1991

C.E. Blackburn[1], M.R. Hallstone[2], C.C. Storey[3] and M.E. Perrault[4]

[1] Resident Geologist, Kenora, Field Services Section, Ontario Geological Survey – Information Services Branch

[2] Geologist, Kenora, Field Services Section, Ontario Geological Survey – Information Services Branch

[3] Drill Core Library Geologist, Kenora, Field Services Section, Ontario Geological Survey – Information Services Branch

[4] Compilation Geologist, Kenora, Field Services Section, Ontario Geological Survey – Information Services Branch

INTRODUCTION

The potential for dimension stone in the Kenora Resident Geologist's District is increasingly being recognized, with 5 exploration programs for the commodity underway in 1991. This compares with 2 programs in 1989 and 1990—the years that heralded the recognition that this potentially vast resource is virtually untapped.

However, exploration for metallic minerals in the district continued to decline from the peak period of 1988, with 40 projects by prospectors and mineral-exploration companies underway. Gold-exploration projects totalled 33, compared with 50 in 1990 and 62 in 1989. The other 7 projects out of the 1991 total were directed at volcanogenic and magmatic base metal targets with the interest in platinum group metals that was evident during the period 1986 to 1988 having subsided. Seven major mining companies and 9 junior companies had exploration projects in the district. For the second year in a row, no advanced exploration was conducted on the 3 underground-development projects for gold that have been underway in recent years: Nuinsco Resources Ltd.—Deak Resources Corporation at Cameron Lake; Consolidated Professor Mines Limited at the past-producing Duport Mine, Shoal Lake; and Boise Cascade Canada Ltd. at the old Scramble Mine prospect near Kenora.

Production of pink dimension stone by Nelson Granite and by Granite Quarriers (G.Q.I.) Incorporated continued at 2 quarries both of which are in Docker Township near Vermilion Bay. Crystal Quarries Limited continued to produce white quartz from a quarry south of Vermilion Bay for both decorative purposes and for use as a high-purity quartz.

Gold concentrate was produced at 2 small-scale-mining operations, one near Dryden and a second at the past-producing Olive Mine near Mine Centre.

At the Kenora Resident Geologist's office, a mineral-deposit compilation to be entered into the Mineral Deposit Inventory (MDI) was continued under contract; this work will become part of the computerized, province-wide data base for geoscience exploration—the Geoscience Exploration Database (GED). Ongoing programs at the Kenora office included visits to and studies of 21 mineral properties and other potential mineral areas; acquisition of exploration diamond-drill core from the Kenora, Red Lake and Patricia mining divisions; monitoring of exploration activity; preparation of computerized, digital geological-data-inventory maps and assessment file index maps; provision of geoscience information and professional advice to mineral explorationists; a prospecting course; and field trips, talks and displays for geologists, prospectors and the general public.

MINING ACTIVITY

There was no major precious metal or base metal production from mining in the Kenora Resident Geologist's District in 1991.

Dimension Stone

Production of granite dimension stone continued at 2 quarries in Docker Township. The pink, granitic stone has been quarried by Nelson Granite (a division of Nelson Monuments Limited, Sussex, New Brunswick) since 1981 and by Granite Quarriers (G.Q.I.) Incorporated of Beebe, Quebec, since 1984. The latter quarry has operated intermittently since 1948. During 1991, quarrying was conducted under contract by Otancan Quarriers which were scheduled to produce 10000 cubic feet of stone.

Decorative Stone

Crystal Quarries Limited continued to extract white quartz from a vein located adjacent to a forest-access road approximately 30 km due south of the town of Vermilion Bay. The quartz is used as landscaping stone and as exposed aggregate in precast concrete panels.

High-Purity Quartz

Crystal Quarries Limited developed a new market for its white-quartz vein located south of Vermilion Bay. A contract was struck with Dow Corning to supply pure quartz for use in the manufacture of silicone sealants. In 1991, 2200 tons was shipped to their new smelter in East Selkirk, Manitoba.

Small-Scale Mining

A. Kozowy (Prospector, Dryden) continued production of a gold concentrate at his Flambeau Lake plant which is situat-

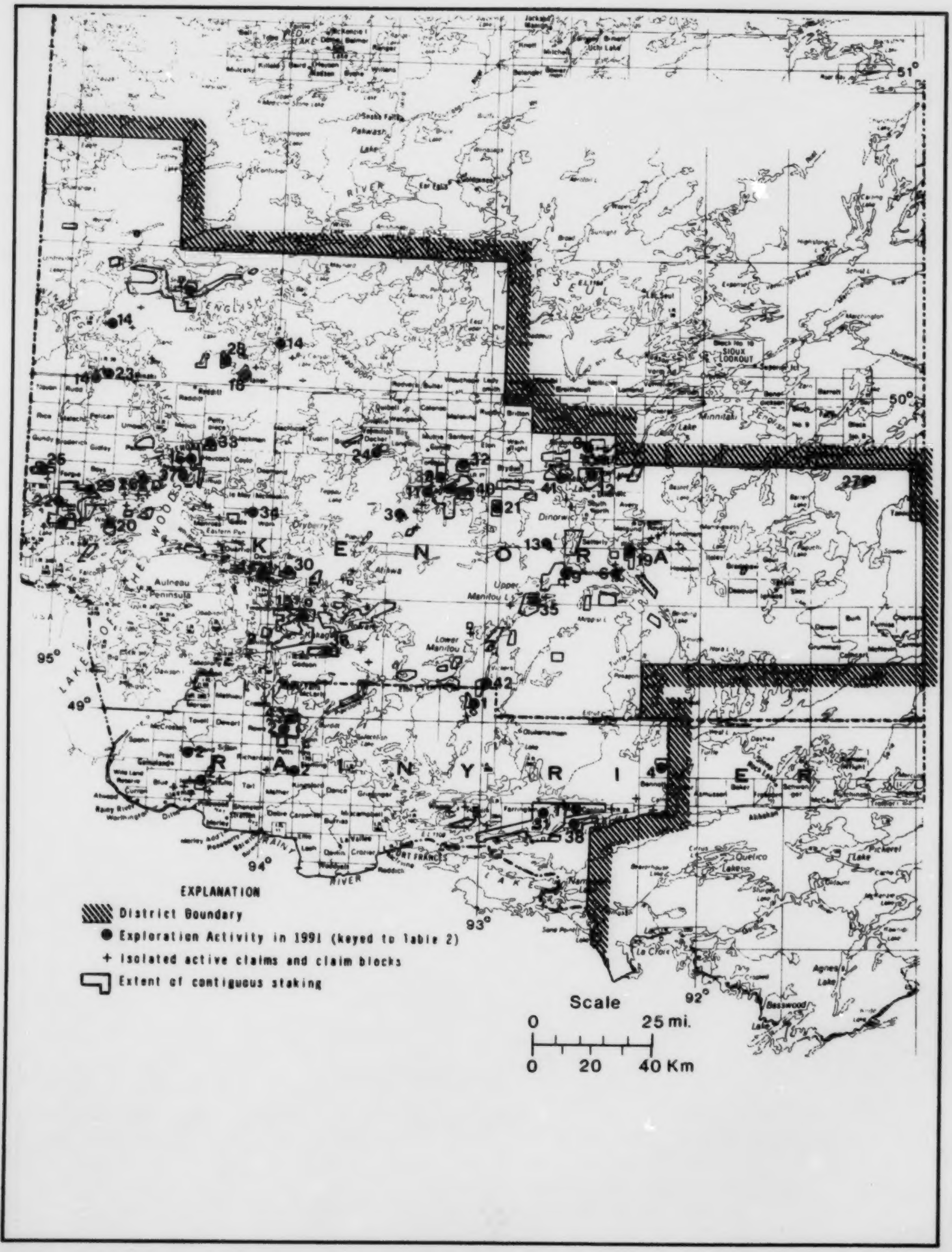

51°
50°
95°
49°
94°
93°
92°
ENGLISH RIVER
LAKE SEUL
SIOUX LOOKOUT
Minnitaki Lake
Aulneau Peninsula
LAKE OF THE WOODS
Upper Manitou L.
Lower Manitou L.
Dinorwic
KENORA
RAINY RIVER
FORT FRANCES
RAINY LAKE
Quetico Lake
Pickerel Lake
Agnes Lake
Basswood Lake
U.S.A.
EXPLANATION
▨ District Boundary
● Exploration Activity in 1991 (keyed to table 2)
+ Isolated active claims and claim blocks
Extent of contiguous staking
Scale
0
25 mi.
0
20
40 Km

Figure 2.1. Kenora Resident Geologist's District: staking and exploration.

ed close to Dryden in Van Horne Township. Mr Kozowy commenced production of concentrate in 1988 and utilizes a small crusher, ball mill, sluice box, accelerator and shaking table. Ore-bearing rock is obtained from his Flambeau Lake deposit, and from the Brockman deposit north of Church Lake in the Kawashegamuk Lake area.

E. Ludwig (Nighthawk Drilling, Porcupine, Ontario) produced gold concentrate from approximately 2500 tons of retrieved broken ore together with other ore mined from the second (-138 feet) level at the past-producing Olive Mine, Mine Centre. Funding for a demonstration study of small-scale mining and ore processing, as part of this project, was provided under the Resource Diversification and Development Program of NORFUND which is administered by the Northern Ontario Heritage Fund Corporation.

ADVANCED EXPLORATION AND DEVELOPMENT

No further work was conducted in 1991 at any of the 3 underground-development projects that have been underway in recent years.

At the Cameron Lake property of Nuinsco Resources Ltd., in which Deak Resources Corporation holds a controlling 53.8% interest, no underground or surface exploration has been conducted since 1989. Proven, probable and possible reserves from surface to -2600 feet stand at 3.1 million tons grading 0.17 ounce Au per ton, with preproduction capital costs based on a 1000 ton-per-day mill estimated to be $22.7 million.

At the Duport Mine (the Shoal Lake property of Consolidated Professor Mines Limited) no underground or surface exploration has been conducted since 1987. Proven and drill-indicated reserves at the mine stand at 2 million tons averaging 0.35 ounce Au per ton, with preproduction capital costs based on milling 450 tons of ore per day estimated to be $52.9 million. The entire project is presently being reviewed under the Environmental Assessment Act.

At Boise Cascade Canada Ltd.'s wholly owned Scramble Mine gold property (10 km northeast of Kenora), neither exploration nor development has been conducted since 1988 on either the surface or underground. Rudimentary reserve estimates by the company vary from 140 000 tons grading 0.42 ounce Au per ton to 270 000 tons grading 0.18 ounce Au per ton.

EXPLORATION ACTIVITY

With the implementation of the new Mining Act in midyear, assessment credits are now assigned by dollar value instead of by man-days (Table 2.1), thus, making it impossible to use this to compare exploration activity in 1991 with that in previous years. However, when measured by number of projects (Table 2.2, Figure 2.1), exploration in the Kenora Resident Geologist's District dropped for the fourth year running, with there being 44 projects in 1991 compared with 65 in 1990, 74 in 1989 and 107 in 1988.

Six major-mining companies (Asarco Exploration Co. of Canada Ltd., Bond Gold Canada Inc., Inco Limited, Noranda Exploration Company, Ltd., Rio Algom Exploration Inc. and Teck Explorations Ltd.) continued programs that had been ongoing from previous years, and 1 major-mining company, Phelps Dodge Corp. of Canada Ltd., commenced a new program. Seven junior-mining companies (Champion Bear Resources Ltd., International Platinum Corporation, Mimiska Mining Company Inc., Seine River Resources Inc., Wellington Cove Explorations Ltd., Western Troy Capital Resources Ltd., Willingdon Resources Limited) continued programs from previous years, and 2 junior-mining companies conducted new programs (Freewest Resources Inc., Match Capital Resources Corporation).

Eighteen projects (41% of the total number of projects in the Kenora Resident Geologist's District) were conducted by prospectors compared with 28 in 1990 (43% of the total number of projects): 11 of these were done with the help of funding from the Ontario Prospectors Assistance Program (OPAP) compared with 16 in 1990— the first full year of the program. Other prospecting activities are known to have been done both with the assistance of OPAP and independently.

Gold continued to be the commodity most sought after, since only 3 projects by exploration companies and 4 of the prospecting projects were directed at base metals as their primary target. The potential for dimension stone in the district continues to be recognized, with 5 projects being active in 1991 when compared with 2 in 1990.

Gold and Base Metals

Exploration for metallic minerals continued, but at a much-reduced rate, in the 4 major greenstone belt areas that have been actively explored since about 1983: the Lake of the Woods—Shoal Lake area, Kakagi—Rowan—Pipestone lakes area, the Manitou—Wabigoon—Eagle lakes area, and the Fort Frances—Mine Centre area. Interest which started in 1988 in the Umfreville—Treelined lakes area, north of Kenora, continued. Follow-up work to a geophysical survey which was released by the Ontario Geological Survey was done within the extension of the Sturgeon Lake greenstone belt into the Barrel Lake area, this being located in the northeastern part of the Kenora Resident Geologist's District.

LAKE OF THE WOODS—SHOAL LAKE AREA

Bond Gold Canada Inc. briefly continued exploration at Shoal Lake on its option from Kenora Prospectors and Miners Limited that includes the past-producing Mikado and Cedar Island (Cornucopia) mines among other gold

TABLE 2.1. Summary of claims recorded and assessment work credit, Kenora Resident Geologist's District, 1991.

Year	Claim Units Recorded	Claim Units Cancelled	Claim Units Active	Diamond Drilling*	Geophysical Surveys*	Geological Surveys*	Total*
1991	1678	2816	8293	$479 627	$ 42 582	$21 522	$582616
				5085	5499	2300	18390
1990	1263	4207	9431	31970	56517	12356	130170
1989	2875	3370	12375	56599	103573	11359	205619
1988	3531	2639	12694	119947	267990	16957	443554
1987	5211	2578	12496	86321	153077	12067	251465
1986	4041	5054	9863	64099	47883	9698	144837
1985	2216	5195	10875	55090	185148	29765	292729
1984	3216	3042	13854	36055	281359	23670	364692
1983	11061	1472	13635	35746	42221	12006	106397
1982	1579	1609	4046	23525	26270	5330	68439
1981	2121	846	4076	26127	37624	3383	72732
1980	1877	788	3208	15428	3149	859	21368
1979	984	1357	2119	9992	10658	1420	24182
1978	808	1357	2300	22299	7576	2143	34934
1977	1495	1585	2820	15405	11366	1760	33838
1976	1380	2125	3234	25030	21367	5960	55042
1975	1677	2452	3975	23584	31509	940	57266
1974	2653	1076	4727	29496	18049	3070	52134

* These values are in man-days up to end of May, 1991; dollar values are given following this date.

prospects. In March, 1991, the company drilled 6 diamond-drill holes, for a total of 1739 feet, on 2 targets situated beneath Helldiver Bay. The first target, in the middle section of the bay, was at the intersection of 2 "cross trends" (assessment files, Resident Geologist's office, Kenora), which drill logs indicate to be the locus of a "mineralized quartz vein shear/breccia zone", containing pyrite and a variety of alteration minerals, including chlorite, fuchsite, sericite and tourmaline. The second target was at the northwestern end of the bay, on the southeastern extension of the structure hosting the past-producing Olympia Mine. Possible visible gold was reported at one point in the drill core. Bond Gold Canada Inc. dropped its option on the entire property in April of 1991, thus, returning 100% interest to Kenora Prospectors and Miners Limited. Preliminary reserves resulting from the 5 year program were reported to be 1.23 million t grading 9.62 g/t Au (*The Northern Miner*, May 6, 1991, p.3).

Mimiska Mining Company Inc. continued exploration, primarily for gold, commenced in 1989 on ground along and adjacent to the Duport deformation zone at Shoal Lake, formerly under the name of Mimiska Mining Company Inc.'s affiliate, Exploration Brex Inc. In March, 1991, one 152 m diamond-drill hole was drilled about 1 km northeast of Felix Island on a mining claim optioned from J. Tomac. The hole was drilled to test a conductor, which was previously identified by a horizontal-loop electromagnetic (HLEM) survey that was conducted by BP Exploration Canada Ltd. in 1983; this conductor proved to be due to graphite with no significant mineralization (assessment files, Resident Geologist's office, Kenora).

Noranda Exploration Company, Limited, commenced exploration in early 1991 on the Purdex gold prospect, Ewart Township, under option from Consolidated Jalna Resources Ltd. Exploration programs, including 18 diamond-drill holes, by the latter company in 1988 and 1989 led them to calculate drill-indicated reserves of 250 000 tons grading 0.25 ounce Au per ton. In 1991 Noranda Exploration Company, Limited, drilled 2 diamond-drill holes, totalling 364 m, to test the west extension of the P zone. Only 1 drill hole hit the zone with the best intersection in the zone assaying 0.18 ounce Au per ton over 3.75 feet (*George Cross News Letter*, April 15, 1991). It was also reported that Noranda Exploration Company, Limited had identified a strong, conductive anomaly through detection by an induced-polarization survey. This anomaly is associated with a previously identified target that the optionee had delineated using a combination of very low frequency electromagnetic (VLF-EM) and magnetic surveys, and soil and rock chip sampling surveys (the rock-chip sample returned values of 1240 ppb Au); this target occurs within the Central zone along strike to the southeast of the Purdex deposit. Three short drill holes, totalling 166 feet, were susequently drilled to test this and

TABLE 2.2. Exploration activity during 1991, Kenora Resident Geologist's District

ABBREVIATIONS

DD	Diamond Drilling	IP	Induced Polarization Survey
DS	Dimension-Stone Sampling	Mag	Magnetometer Survey
EM	Electromagnetic Survey	Prosp	Prospecting
GC	Geochemical Survey	SA	Sampling
GL	Geological Survey	STr	Stripping
GP	Geophysical Survey	Tr	Trenching

Number On Figure	Individual or Company	Area/Township	Activity
1	Angove, Richard	Vista Lake area	EM,Mag
2	Asarco Exploration Co.	Menary, Nells, Sutherland and Potts	GP townships
3	Barton, Bernard	Garnet Bay area	STr,Tr
4	Bolen, Jack and Al McCormick	Sandbeach Lake area	EM
5	Bond Gold Canada Inc.	Shoal Lake Area	DD
6	Doherty, William	Kawashegamuk Lake area	STr,Tr,SA
7	Champion Bear Resources Ltd.	Laval Township	GP
8	Champion Bear Resources Ltd.	Paterson Lake area	DD,SA,GL
9	Freewest Resources Inc.	Boyer Lake area	GC,Mag,EM,Tr,SA
10	Freewest Resources Inc.	Zealand, Brownridge and Laval	Prosp townships
11	Glatz, Alex	Temple Township	Prosp,SA
12	Glatz, Alex and A. Kozowy	Hartman Township	Prosp
13	Glatz, Alex and A. Kozowy	Turtlepond Lake area	Prosp
14	Hill, Jo	Swan, Goshawk and Scenic lakes areas	DD
15	Hood, Bill	Dogpaw Lake area	GL,GC
16	Hood, Bill	Jaffray Township	GL,GC
17	Inco Limited	Little Turtle Lake area	STr,IP,GL
18	Manex Granit Inc.	Wonderland Lake area	DS
19	Match Capital Resources Corp.	Melgund Township and Tabor Lake area	DD,GP
20	McLandress, Ian	Wiley Bay area	STr,EM
21	Mimiska Mining Co. Inc.	Contact Bay area	DD,Mag,EM
22	Mimiska Mining Co. Inc.	Snowshoe Bay area	DD
23	Minor, J.A	Swan Lake are	STr,Tr
24	Nelson, Carter	Docker Township	STr,Tr
25	Noranda Exploration Co. Ltd.	Ewart Township	IP,DD,GL,Prosp
26	Noranda Exploration Co. Ltd.	Clearwater Bay area	Tr,D27
		Noranda Exploration Co. Ltd. Pass Lake	EM,Mag,DD
28	Palin Granite Canada Inc.	Wonderland Lake area	DD,DS
29	Perry, Bruce	Glass Township and Echo Bay area	GC,STr,SA
30	Phelps Dodge Corp.	Lobstick Bay area	EM,Mag,IP,DD
31	Pitkanen, Ray	Bad Vermilion Lake area	Prosp
32	Plomp, Fred	Aubrey Township	Prosp,SA
33	Pogson, Gordon	Haycock Township	STr
34	Pogson, Gordon	Code and LeMay townships	STr,Tr
35	Redden, J.W.	Boyer Lake area	STr,GL,SA
36	Rio Algom Exploration Inc.	Heronry and Brooks lakes areas	DD
37	Roberecki, Ed	Bigstone Bay area	STr,Tr
38	Seine River Resources Inc.	Bad Vermilion Lake area	DD
39	Teck Explorations Ltd.	Aubrey Township	GL,STr
40	Teck Explorations Ltd.	Buchan Bay area	DD,SA,EM
41	Teck Explorations Ltd.	Zealand Township	DD,Tr
42	Wellington Cove Explorations	Vista and Sakwite lakes areas	DD
43	Western Troy Capital Resources	Menary Township	Prosp,GL,STr, Inc. Tr,SA
44	Willingdon Resources	Willingdon Township	DD

other targets, but no significant gold values were obtained and Noranda Exploration Company, Limited, terminated the option following this work (*Vancouver Stockwatch*, July 16, 1991). Also in the High Lake area and in conjunction with the program at the Purdex prospect, the company did induced-polarization (IP) and geological surveys, prospecting and sampling on their Pogson, Fairservice and Busch options (D. Fitzpatrick, Noranda Exploration Company, Limited, personal communication, 1991).

Noranda Exploration Company, Limited, commenced exploration on their Abernathy Lake gold prospect which was purchased from Mingold Resources Inc. The latter company had undertaken drilling in 1985 and a combined geological, geochemical and geophysical program conducted during the period 1989–1990 (assessment files, Resident Geologist's office, Kenora). This work led to the outlining of a favourable gold zone, along the contact between volcanic and sedimentary rocks, as was given by anomalous soil- geochemistry values and magnetic and electromagnetic anomalies. A zone of sulphides was outlined by Noranda Exploration Comany, Limited which then carried out additional prospecting, excavated 18 trenches and followed with the drilling of 3 short diamond-drill holes late in 1991 (W. Reid, Noranda Exploration Company, Limited, personal communication, 1991).

Other work done in the Lake of the Woods—Shoal Lake area included the following:

- Electromagnetic surveys and trenching were performed by I. McLandress on his claim group at Hatmaker Lake, Western Peninsula, that includes the Florence or Hatmaker Lake gold occurrence (assessment files, Resident Geologist's office, Kenora).
- Stripping, humus geochemical sampling and sampling for assay was done by B. Perry on 2 claim groups at Echo Bay (assessment files, Resident Geologist's office, Kenora). Grab samples from the Echo Bay adit-vein assayed up to 1.01 ounces Au per ton (B. Perry, Prospector, personal communication, 1991).
- Stripping, trenching and sampling for assay were done by G. Pogson on his Peninsula and Pipeline gold occurrences at Black Sturgeon Lake, Haycock Township, and around the Witch Bay and Stella gold prospects in Code Township (assessment files, Resident Geologist's office, Kenora).The following best-assay results were obtained: 0.16 ounce Au per ton in quartz and pyrite at the Peninsula occurrence, 0.40 ounce Au per ton across 1.2 m of quartz and pyrite at the Pipeline occurrence, and 0.84 ounce Au per ton across 2 feet at the Witch Bay prospect (G. Pogson, Prospector, personal communication, 1991).
- Stripping was done by E. Roberecki at the past-producing Sultana gold mine, Bigstone Bay (assessment files, Resident Geologist's office, Kenora).
- Humus and mineral-soils geochemical sampling, and geological mapping was pursued by geologist W. Hood around the Horne-Thrasher gold occurrence, Jaffrey Township (W. Hood, personal communication, 1991).

KAKAGI—ROWAN—PIPESTONE LAKES AREA

Rio Algom Explorations Inc. concluded an exploration program for gold that had commenced in 1989 at the eastern end of Kakagi Lake on claims acquired both by staking and through options with Laramide Resources Ltd., Marbank Minerals and Calnor Resources Ltd. Previous work had included ground magnetometer, IP and geological surveys, and a diamond-drilling program along an east-trending zone between Hay Island in the west, East Island in the central portion, and the mainland at the eastern end of the lake. In the vicinity of East Island, strongly altered (silicification, sericitization, pyritization) and sheared pyroclastic and flow rocks were encountered. In the 1991 drilling program, 7 holes, for a total of 2282 m, were drilled early in the year from rigs erected on the lake ice between Hay Island and East Island (assessment files, Resident Geologist's office, Kenora). Gold-analysis values were in the tens to hundreds of parts-per-billion range, however, an exception came from 1 analysis which yielded a value of 2817 ppb Au over a 1.5 m width. This occurs within a 16 m section that was logged as brecciated quartz diorite in 1 hole (assessment files, Resident Geologist's office, Kenora).

Phelps Dodge Corp. of Canada Ltd. commenced an exploration program for gold on ground optioned from R. Fairservice both along and north of the north shore of Lobstick Bay, Lake of the Woods. Gold in this area is associated with fluorite in silicified, sericitized, pyritized and predominantly felsic volcanics of the Berry River formation (Johns et al. 1984). Previous work by other companies, notably BP Canada Inc., had been concentrated at the eastern end of the zone in the vicinity of the Lobstick Bay-Thrasher occurrence. In 1991, Phelps Dodge Corp. of Canada Ltd. conducted electromagnetic and magnetic surveys (assessment files, Resident Geologist's office, Kenora), IP surveys and follow- up drilling (M. Johnson, Phelps Dodge Corp. of Canada Ltd., personal communication, 1991).

Willingdon Resources Limited drilled 4 diamond-drill holes, for a total of 2284 feet, on its Oliver Severn gold prospect at Sioux Narrows, Willingdon Township (G.S. Cross, Willingdon Resources Limited, personal communication, 1991), where gold occurs in narrow quartz veins within a northwest-trending shear zone that extends into Sioux Narrows Provincial Park.

Other work done in the Kakagi—Rowan lakes area included humus and mineral-soils geochemical sampling, and geological mapping. This was performed by geologist W. Hood who targeted base metals and gold in an area near

Stephen Lake, north of Kakagi Lake (W. Hood, personal communication, 1991).

UMFREVILLE—TREELINED LAKES AREA

Champion Bear Resources Ltd. continued its exploration program in the Separation Lake greenstone belt, commenced in 1988, which continued work started by Shabu Gold Mines Ltd. in late 1987. The company's interest extends along a major portion of the greentone belt, from Umfreville Lake in the west to Helder Lake in the east—a distance of 45 km—and encompasses both gold and base metal occurrences. In early 1991, 40 diamond-drill holes, for a total of 4324 m, were drilled at the western end of their property. Twenty two of these holes tested the Gauthier (One Man Lake) base metal-gold prospect at Umfreville Lake, and a further 18 tested scattered base metal and gold targets along strike to the east (assessment files, Resident Geologist's office, Kenora). In a press release in April, 1991, the company stated that at the Gauthier (One Man Lake) prospect, gold is associated with subparallel, silicified breccia zones and that these breccia zones have been drilled over a strike length of 900 m and to a depth of 100 m. To the east of the Gauthier prospect, copper-zinc mineralization was discovered during geologic mapping and other work done in 1989 and 1990. Company geologists interpret the mineralization to be occurring at the contact between rhyolite and basalt and to be different from the gold-arsenic association at the Gauthier (One Man Lake) prospect. This contact has been traced for a strike length of 30 km. Low copper and zinc assays were obtained from all 13 holes that intersected this contact over widths of up to 24 m, and these values were obtained from semimassive and stringer sulphide-bearing zones. Best values found include 0.30% Zn over 24 m, 0.34% Zn over 9.3 m and 0.45% Zn over 4.3 m (assessment files, Resident Geologist's office, Kenora). Over the summer of 1991, further geological mapping, trenching and sampling was conducted on the base metal targets outlined by geophysical surveys (L. Chastko, Champion Bear Resources Ltd., 1991). This exploration program is further discussed under the subheading "Base and Precious Metals in the Separation Lake Greenstone Belt" in this report.

MANITOU—WABIGOON—EAGLE LAKES AREA

Mimiska Mining Company Inc. conducted an exploration program for nickel and copper on 42 claims over the Nabish Lake gabbroic intrusion, which is located south of Dryden, between December, 1990, and March, 1991. The intrusion has been a scene of exploration for these commodities since the 1950s, and in 1990, prospectors A. Kozowy and A. Glatz had uncovered additional copper-nickel mineralization by trenching in the northwest lobe of the intrusion (Blackburn et al. 1991, p.18-19). Initial grab sampling by Mimiska Mining Company Inc. (*The Northern Miner*, December 24, 1990, p.18) returned assays of 4% Cu, 2.01% Ni and 0.05 ounce Pt per ton from the newly opened trench. Mimiska Mining Company Inc. conducted both magnetometer and VLF, Max-Min and vertical loop electromagnetic surveys, followed by the drilling of 7 diamond-drill holes, for a total of 610 m. Five of the drill holes were targeted on the trench area and 2 were positioned on a target at the north end of Nabish Lake (assessment files, Resident Geologist's office, Kenora). Results obtained from 2 shallow drill holes beneath the trench included a 1.5 m section that had assayed 0.91% Ni and 0.52% Cu, a 1.28 m section that had assayed 0.62% Ni and 0.39% Cu in one of the holes and a 0.65 m section that had assayed 0.53% Ni in a second hole. No significant values were obtained in the other 3 holes. W. Yeomans, Mimiska Mining Company Inc., concluded that the mineralization at surface did not extend to depth (assessment files, Resident Geologist's office, Kenora).

Teck Corporation continued an exploration program for base metals which was started in 1987 by International Platinum Corporation at Eagle Lake. In 1990, Teck Corporation entered into a joint-venture partnership with International Platinum Corporation to work on the property. In February and March, 1991, 7 diamond-drill holes were drilled, for a total of 1059 m, at 6 locations along a 10 km strike length from southwest of Farabout Peninsula to northeast of Partridge Point on the same peninsula (assessment files, Resident Geologist's office, Kenora). All drill holes were drilled to test electromagnetic anomalies which proved to be due to pyrite and pyrrhotite mineralization. Trace amounts of sphalerite were noted, but copper and zinc assays were uniformly low.

Teck Corporation continued an exploration program for gold begun in 1990 east of Thunder Lake, in Zealand Township, on both staked ground and a number of privately owned parcels. The property includes units mapped by Satterly (1943) as metagreywackes, arkoses and magnetite iron formations of the Thunder Lake sedimentary series. A diamond-drilling program was conducted in the spring of 1991, totalling 4300 m in 24 holes, and stripping has been done in 23 areas (K. Thorsen, Teck Corporation, personal communication, 1991).

Wellington Cove Explorations Ltd. continued its exploration program for gold begun in 1989 at the Smooth Rock Lake occurrence, at the south end of Vickers Lake. In March, 1991, 13 diamond-drill holes were drilled, for a total of 3229 feet, to test geological and geophysical (IP, VLF-EM and magnetic) targets both along a zone extending 5 km south-southwest from the original occurrence and including the occurrence itself (assessment files, Resident Geologist's office, Kenora). Among those tested was the newly discovered Angove occurrence. Low gold assays were obtained from drill core in a number of drill holes.

Freewest Resources Inc. conducted soil geochemical, magnetic and electromagnetic surveys, and trenching and sampling for assay on a 102 unit claim group. This claim group had been acquired by option from R.W. Fairservice and by staking on either side of Highway 502 south of Peak

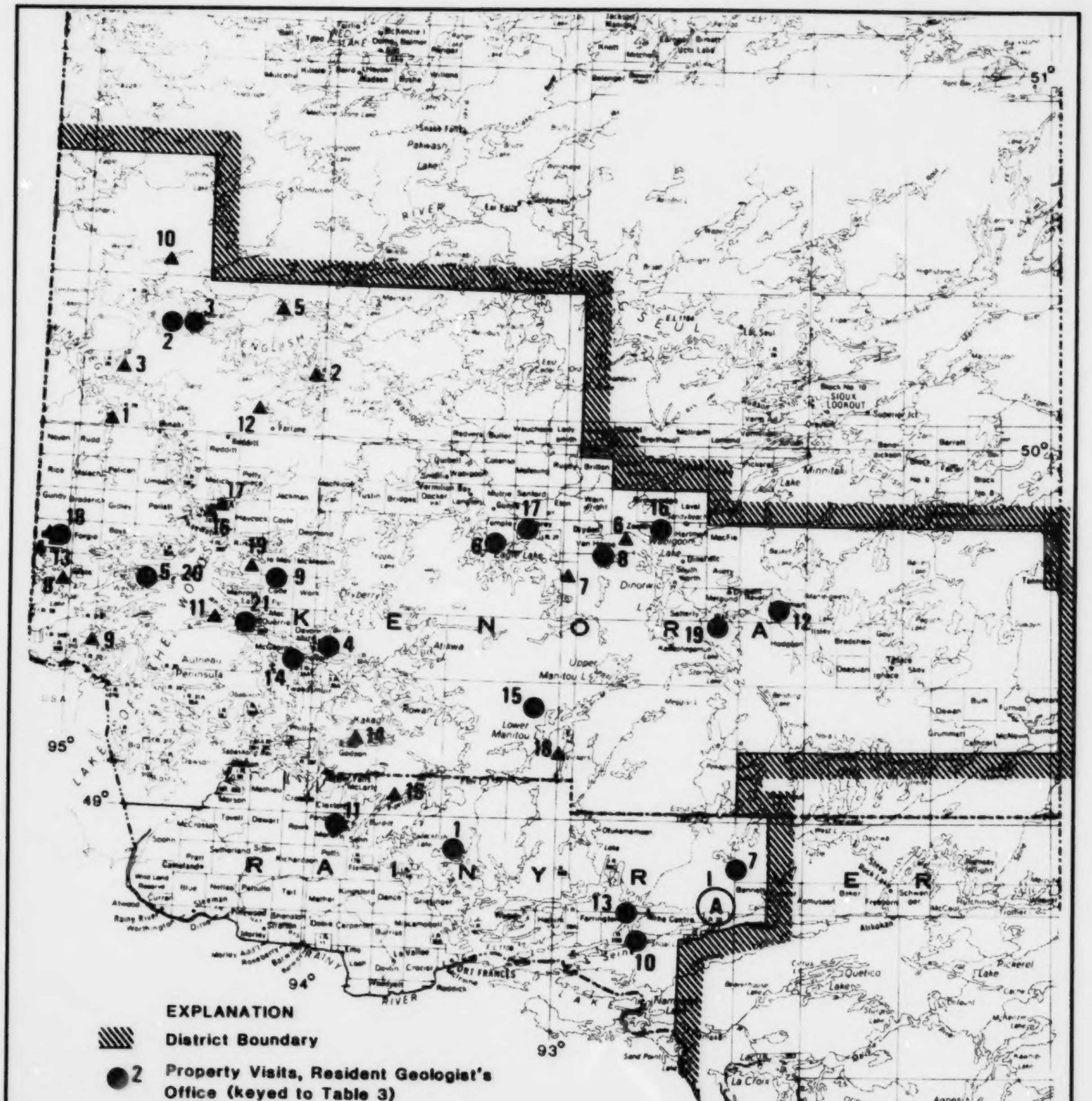

K E N O R A
R A I N Y R I V E R
51°
50°
95°
49°
94°
93°
92°
SEUL
ENGLISH
RIVER
SIOUX LOOKOUT
Aulneau Peninsula
Upper Manitou L.
Lower Manitou
Quetico
LAKE OF THE WOODS
FORT FRANCES
RAINY RIVER
U.S.A.
EXPLANATION
District Boundary
Property Visits, Resident Geologist's Office (keyed to Table 3)
Diamond-drill core collection sites (keyed to Table 4)
Location of OGS Field Party, 1991 (keyed to text)
Scale
0
25 mi.
0
20
40 Km

Figure 2.2. Kenora Resident Geologist's District: property visits, diamond-drill core collection sites, OGS field work.

Lake. Four new gold showings were identified and exposed by trenching (M. Fekete, Freewest Resources Inc., personal communication, 1991).

Match Capital Resources did geophysical and reconnaissance geological surveys, and 4600 feet of follow-up drilling on their 26 claim-unit option from J. Redden at the past-producing Sakoose Mine, 10 km south of Dyment (J. Redden, Prospector, personal communication, 1991).

Other work in the Manitou—Wabigoon—Eagle lakes area included the following:

- Electromagnetic and magnetic surveys were done over 2 claim units to check out a gold occurrence along a lineament that included the newly found Angove occurrence (see discussion regarding Wellington Cove Explorations Ltd., above). This was undertaken by R. Angove at the northern end of Twist Lake, southeast of Vista Lake (assessment files, Resident Geologist's office, Kenora).
- Stripping, trenching and sampling was conducted by W. Doherty at Kawashegamuk Lake (assessment files, Resident Geologist's office, Kenora).
- Stripping, geological mapping and sampling was accomplished by J. Redden at both Trafalgar Bay on the Canamerica E Zone and also north of Goldrock, Upper Manitou Lake (J. Redden, Prospector, personal communication, 1991).
- Prospecting on 135 claim units in Zealand, Brownridge and Laval townships was carried out by Freewest Resources Inc. (M. Fekete, Freewest Resources Inc., personal communication, 1991)
- Stripping and trenching on the S500 and Barton gold occurrences was carried out by B. Barton near McKinstry Lake (B. Barton, Prospector, personal communication, 1991).
- A. Glatz and A. Kozowy prospected in Hartman and Temple townships for gold, and at Emmons Lake west of Stanawan Bay, Dinorwic Lake, for copper and nickel (A. Glatz, Prospector, personal communication, 1991).
- Prospecting was done by Fred Plomp in Aubrey Township (F. Plomp, Prospector, personal communication, 1991).

FORT FRANCES—MINE CENTRE AREA

Seine River Resources Inc. continued exploration commenced in 1987 on its 45 claim-unit property, that includes the Smylie and Dinosaur gold occurrences, immediately north of the Seine River at Wild Potato Lake. Two diamond-drill holes were reportedly drilled early in the year (*The Chronicle Journal*, March 4, 1991).

Western Troy Capital Resources Inc. continued an exploration program commenced in 1989 in Menary Township. In a press release dated November, 1991, the company announced that gold mineralization had been discovered in quartz veins within mafic metavolcanics close to the contact with granites of the Sabaskong batholith. Prospecting, geological mapping, stripping and trenching in 1991 had confirmed the presence of visible gold in several locations; namely, in 7 quartz veins in a zone 25 m wide by 125 m long, in 2 veins 100 m to the east and in 4 adjacent areas along the contact over a strike length of 4 km. Composite samples taken from 5 different veins were said to have ranged in value from 0.85 ounce Au per ton to 2.045 ounces Au per ton.

Asarco Exploration Co. of Canada Ltd. continued a program of gold exploration, focussed on the Rainy River lowlands, by conducting geophysical surveys in Menary, Nelles, Sutherland and Potts townships (R. Dean, Asarco Exploration Co. of Canada Ltd., personal communication, 1991).

Inco Limited, following an airborne electromagnetic and magnetic survey flown late in 1990, did stripping and trenching (assessment files, Resident Geologist's office, Kenora), and IP and geological surveys on a claim block both along and north of Highway 71 immediately east of Mine Centre (R. Bell, Inco Limited, personal communication, 1991). This work followed from an option from R. and L. Cousineau of ground around the Pidgeon copper-zinc prospect.

Other work in the Mine Centre area included:

- the carrying out of an electromagnetic survey by J. Bolen and A. McCormick over their newly discovered copper-nickel occurrence on the Grey Trout road, north of Bennett Township
- prospecting and sampling for assay by R. Pitkanen in the vicinity of the Stellar gold prospect at Bad Vermilion Lake (R. Pitkanen, Prospector, personal communication, 1991)

BARREL LAKE AREA

Noranda Exploration Company Ltd. conducted follow-up work on a 10 unit claim block staked over an electromagnetic anomaly east of the north end of Barrel Lake. Exploration followed the release of an airborne geophysical survey (OGS 1990) which was made over the southwest extension of the Sturgeon Lake greenstone belt. Ground surveys identified 2 conductors with coincident magnetic signatures, and follow-up diamond drilling, for a total of 260 m in 2 holes, intersected pyrite- and pyrrhotite-bearing sulphide zones devoid of potentially economic minerals (R. Felix, Noranda Exploration Company, Limited, personal communication, 1991).

Industrial Minerals

DIMENSION STONE

Nelson Granite Ltd. continued to strip outcrops adjacent to the company's producing quarry located west of the town of Vermilion Bay in Docker Township (assessment files, Resident Geologist's office, Kenora).

Palin Granite Canada Inc., following the drilling in late 1990 of 3 diamond-drill holes each on the order of 20 feet, extended one of the holes to 60 feet, drilled a fourth hole to 40 feet and quarried 13 granite blocks (G. Zebruck, Palin Granite Canada Inc., personal communication, 1991). One block was shipped to Granit Bussiere Inc., St. Sebastien, Quebec, 1 block to Castellucci Stone Inc., Providence, Rhode Island, USA, and 2 blocks to dealers in Italy.

J.A. Minor did further stripping on his property close to the Cygnet Lake road which branches off the Whitedog road (assessment files, Resident Geologist's office, Kenora).

Manex Granit Inc. and its affiliate Canital Granite Ltd. removed a granite block, for the purpose of cutting it into tiles, from its property at Red Deer Lake (assessment files, Resident Geologist's office, Kenora).

J. Hill drilled 5 short diamond-drill holes, for a total of 62 m, at 3 dimension-stone sites either on or just outside the boundaries of the Swan Lake, Whitedog Lake (Islington), and Grassy Narrows Indian reserves (J. Hill, Northwood Geoscience, personal communication, 1991). These sites were investigated on behalf of the Assin Partnership, a joint venture of several Indian Bands in the Kenora area.

TABLE 2.3. Property and other visits, Kenora Resident Geologist's District

1 Ash Bay Dome, Manitou Sound area
2 Can-Fer prospect: U
3 Champion Bear Grids A-G (Champion Bear Resources Ltd.) Paterson Lake and Treelined Lake areas: Cu, Zn
4 Fairservice Lobstick Bay option (Phelps Dodge Corp. of Canada Ltd.), Lobstick Bay area: Au
5 Florence prospect and Deadhead zone, Wiley Bay area: Au
6 Glatz Temple Township sulphide zone, Temple Township
7 Grey Trout Road occurrence, Manion Lake area: Cu, Ni
8 Johnson Contact Bay claims, Contact Bay area
9 Lavender Lake occurrence, Code and LeMay townships: Cu
10 McKenzie-Gray prospect (Nipigon Resources), Bad Vermilion Lake area: Au, Zn
11 Menary Township property (Western Troy Capital Resources Inc.), Menary Township: Au
12 Old Showing, Hyndman Township: Au
13 Olive Mine (Nighthawk Drilling), Little Turtle Lake area: Au
14 Oliver Severn prospect (Willingdon Resources Limited), Willingdon Township: Au
15 Petrie occurrence (Black Cliff Mines Ltd.), Barker Bay area: Au
16 Pidgeon Zealand Township occurrence (Teck Corporation), Zealand Township: Au
17 Plomp occurrence, Aubrey Township: Au
18 Purdex prospect (Noranda Exploration Company, Limited), Ewart Township: Au
19 Sakoose Mine prospect (Match Capital Resources), Tabor Lake area: Au
20 Western Peninsula occurrence, Clearwater Bay area: Au
21 Yellow Girl Bay, Manross Township

Note: abbreviations above define metal or element focussed upon.

ONTARIO GOVERNMENT INCENTIVE PROGRAMS

In 1991, 10 exploration projects in the Kenora Resident Geologist's District were designated under the Ontario Mineral Incentives Program (OMIP) for a total of $365 967. Thirty-three projects were approved under the Ontario Prospectors Assistance Program (OPAP) for a total of $322 828.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

Current permanent staff at the Resident Geologist's office include C.E. Blackburn, Resident Geologist; M.R. Hailstone, Geologist; C.C. Storey, Drill Core Library Geologist; C.B. Ravnaas, Assistant Drill Core Library Geologist; and M.J. Guderyan, Secretary. Contract staff during 1991 included the following people: M.E. Perrault, who carried out geological-data compilation; A.J. Raoul, who filled in as Assistant Drill Core Library Geologist; and J.L. Lemay, Clerk-Typist. M. Lengies, J. Buchholz and R. Kurtz worked under the Unemployment Insurance Job Creation Program. During the period January to March, M.R. Hailstone was seconded to the Ontario Prospectors Assistance Program (OPAP) in Sudbury as an evaluator, and commencing in December, 1991, to Elliot Lake as Geologist charged with the responsibility of running the local office.

In 1991, the exploration properties and mineral occurrences listed in Table 2.3 were examined in the field by staff of the Kenora Resident Geologist's office. Companies undertaking exploration on any of these properties or occurrences are indicated in brackets. Their locations are indicated on Figure 2.2.

During 1991, 650 consultations were handled in the office of the Resident Geologist and a further 510 consultations were handled by telephone. The Kenora Drill Core Library received 131 visitors and handled 255 telephone requests for information.

Office staff contributed to 2 Mines and Minerals Division geoscience symposia—1 held in Thunder Bay in April, 1991, and the second held in Toronto in December, 1991—by presenting displays emphasizing the topic of exploration activity in the Kenora Resident Geologist's District; in addition, at the symposium held in Thunder Bay, C.E. Blackburn gave a talk on the same topic.

C.E. Blackburn contributed as a co-author and field facilitator of Field Trip B2, *Archean Volcanolgy and Sedimentolgy of Lake of the Woods—the Classic Keewatin Greenstone Belt* (Ayer et al. 1991), in conjunction with the GAC-MAC-SEG (Geological Association of Canada, Mineralogical Association of Canada and Society of Economic Geologists) joint annual meeting in Toronto in May, 1991. Unfortunately the trip had to be cancelled due to insufficient enrollment, but a less-formal version was held in September, 1991, when 23 geologists from industry and government in Ontario, Manitoba and Minnesota attended.

During 1991, geological-data compilation consisted of the preparation of digital maps and accompanying word-processable data sheets and digital index maps for the office's assessment files. In addition, a comprehensive compilation of 1113 mineral deposits in the Kenora Resident Geologist's District into a data base called the Mineral Deposit Inventory (MDI) was continued under contract by Double Rainbow Exploration Services Inc. (DRESI). This data is part of a computerized, province-wide data base for geoscience exploration—the Geoscience Exploration Database (GED).

The Kenora Drill Core Library, serving the combined Kenora, Red Lake and Patricia mining divisions, had stored 85 150.8 m of completely catalogued drill core by the end of 1991; 5024.7 m of drill core was collected during the year.

M.R. Hailstone, assisted by Resident Geologist's office staff, presented an 18 hour prospecting course in Fort Frances in May, 1991, which ran 3 evenings per week over a 2 week period. Thirty-five people attended, and 20 attended a follow-up field trip.

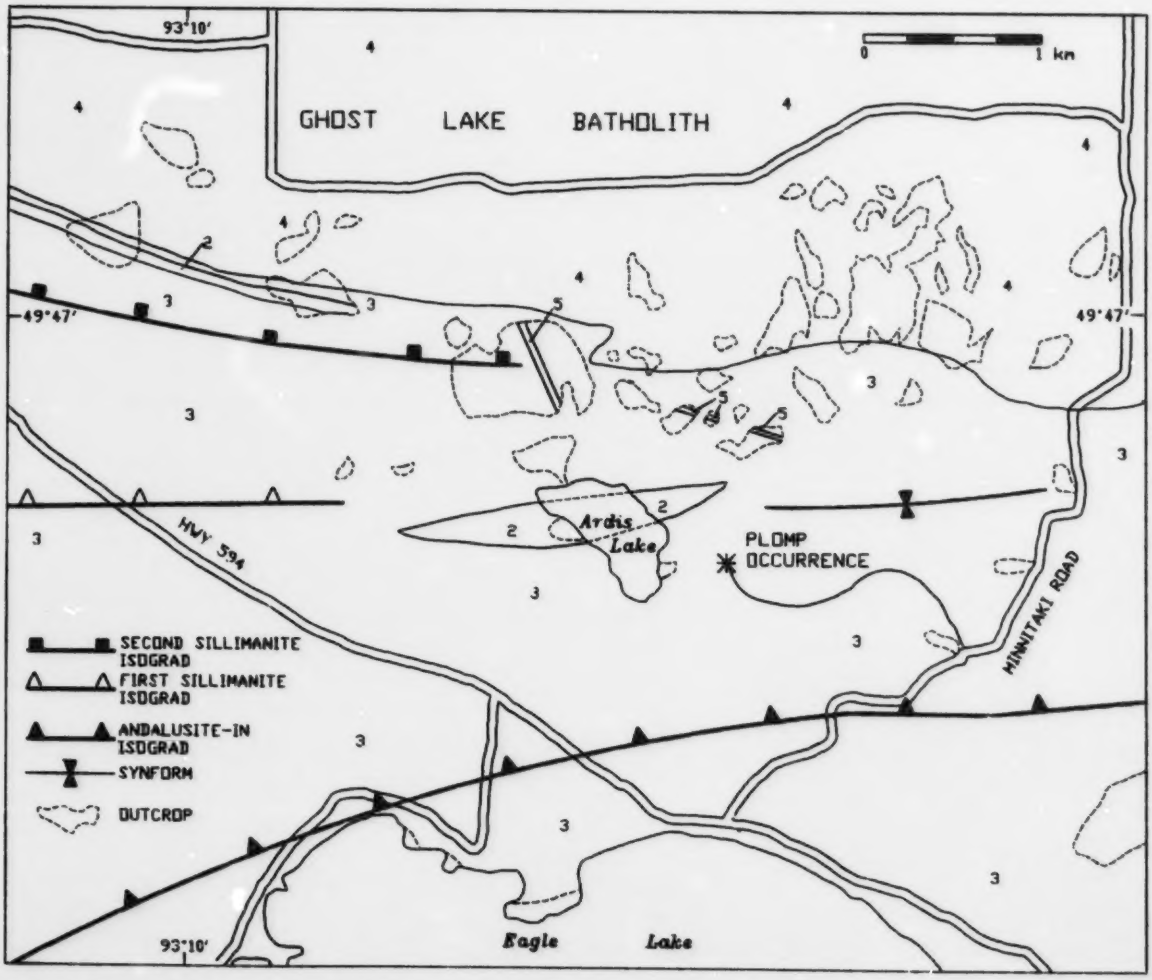


Figure 2.3. Plomp gold occurrence: 1) amphibolitized mafic metavolcanics; 2) metasediments; 3) granitic rocks; 4) diabase dikes. Geology from Breaks and Kuehner (1984); outcrop generalized but indicative of density.

Field trips and talks were provided for the Superannuated Teachers Association of Kenora, for the Dryden High School Conservation Course and for 2 classes at Beaver Brae High School in Kenora. Displays were provided in Kenora for the Ontario Mining Association (OMA) Mining Week, in Sioux Narrows for the community's Heritage Days celebrations and in Keewatin for the Careers Northwest regional career fair.

Office staff attended the annual meeting of the Prospectors and Developers Association of Canada in Toronto, the State of Minnesota Mineral Activities Symposium in Chisholm, Minnesota, and the Manitoba Mineral Activities Forum in Winnipeg, Manitoba.

C.E. Blackburn continued to contribute to the preparation of the Ontario Geological Survey's publication *Geology of Ontario* by providing input into the Tectonic Map of Ontario, and completing, with a team of Mines and Minerals Division geologists, the chapter on the geology of the Wabigoon Subprovince.

ACKNOWLEDGMENTS

Various members of the geological staff contributed to the preparation of the sections that follow hereinafter.

C.E. Blackburn did both the field work for and wrote up the section on Base and Precious Metals in the Separation Lake Greenstone Belt. This author also wrote the section on Recommendations for Exploration.

M.R. Hailstone did both the field work on and wrote up the examination of the following properties: the Plomp gold occurrence, the Grey Trout road copper-nickel occurrence and the Lavender Lake copper occurrence. These discussions fall under the section entitled Property Examinations.

C.C. Storey wrote the section on the Drill Core Storage Program. M.E. Perrault wrote the section on Geological-Data Compilation and did the computer-assisted drawings (CADs) for figures 2.4 through 2.7.

PROPERTY EXAMINATIONS

Plomp Gold Occurrence

The Plomp gold occurrence is located in the south half of Aubrey Township, 20 km west of Dryden, Ontario (Figure 2.3). The property can be accessed by road from Highway 17 and thence turning south onto the Minnitaki road for approximately 6 km whereupon another turn is made to the west to travel a distance of 1.5 km along a timber-access road.

F. Plomp first found the occurrence during January and February of 1991. An initial grab sample containing quartz-vein material was analyzed and gave a result of 9000 ppb Au (F. Plomp, Prospector, personal communication, 1991). F. Plomp has staked 8 claims in the area and owns mineral rights on an additional 2 patented claims.

Gold is hosted by boudinaged quartz-tourmaline veins cutting metawacke and metapelites of the Thunder Lake metasediments. The bedrock geology of the area has been described by Breaks (1989), Blackburn et al. (1982) and Breaks and Janes (1991). Metamorphic grade increases rapidly (approximately 50°C/km as estimated by Breaks (1989)) in the metasediments from a low-metamorphic-grade chlorite zone in the south, at the north shore of Eagle Lake, to the high-metamorphic-grade sillimanite-cordierite-potash feldspar zone flanking the Ghost Lake Batholith in the north. The Plomp gold occurrence is close to the eastward projection of the first sillimanite isograd indicated by Breaks and Kuehner (1984).

Locally, metawackes and metapelites (prominently exhibiting andalusite on weathered surfaces) are intercalated with recrystallized and boudinaged mafic flows or sills up to 1 m thick. The supracrustals are intruded by felsic quartz-eye-porphyry sills up to 50 m thick. These felsic units are commonly sericitized, pyritized and sheared and contain local patches of green mica. Subsequent to visits made to the property by the writer (M.R. Hailstone), F. Plomp claims to have located some molybdenite mineralization in the felsic unit and 20 ppb Au (F. Plomp, Prospector, personal communication, 1991).

Metasedimentary units locally strike 080°. Veins are of 2 types. The first type, boudinaged quartz-tourmaline veins, are parallel to bedding, on the order of 5 cm wide and occur as 1 to 3 m wide swarms with similar strike. Individual veins have tourmaline halos that constitute up to 50% of the vein. The vein swarms are both parallel to and coincident with the axis of a synform that is shown on the Ontario Geological Survey's Preliminary Map P.2623 (Breaks and Kuehner 1984). The second type, massive recrystallized quartz, occur as tension-fracture fillings, that have not been found to contain gold, and as cores within the larger quartz-tourmaline veins. Veins of recrystallized quartz also contain localized, hematized patches and chalcopyrite patches with up to 1% chalcopyrite.

Boudinaged quartz-tourmaline veins in close proximity to boudinaged recrystallized mafic flows or sills appear to be the most favourable sites for gold deposition. The best result from 13 samples collected by M.R. Hailstone from a quartz-tourmaline vein gave an assay of 1.123 ounces Au per ton (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt). This vein occurs within a pinched area of a boudinaged, recrystallized mafic flow.

There is no recorded history of exploration for gold in this immediate area. The sericitized and pyritized felsic sills would appear to be a more desirable gold host than the veins described previously. To date, these have not yielded signifi-

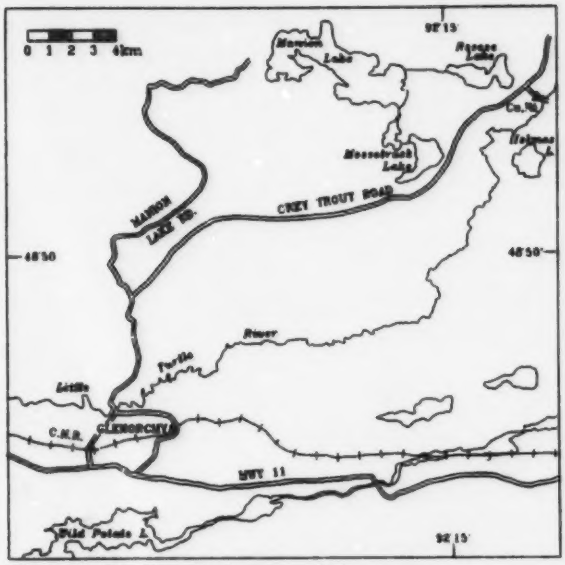


Figure 2.4. Grey Trout Road copper-nickel occurrence.

cant assays, but the presence of molybdenite and fuchsite suggests that further prospecting of these units should be carried out where they occur in the Thunder Lake metasediments.

Grey Trout Road Copper-Nickel Occurrence

The Grey Trout Road copper-nickel occurrence (Figure 2.4) was discovered in the early summer of 1991 by a heavy-equipment operator while constructing the Grey Trout road. Much of the original showing is now under the roadbed. The property has been staked by J. Bolen and partner A. McCormick. Two claim blocks totalling 31 units cover the property.

The property is located 30 km east of Mine Centre and can be accessed by road from Highway 11 by travelling north 12 km on the Glenorchy—Manion Lake road, then east 21 km on the Grey Trout road. The showing is located in a roadcut 100 m north of the bridge crossing the Little Turtle River.

The claims are underlain by rocks of the Irene—Eltrut lakes batholithic complex. Locally the rocks are hornblende-biotite gneisses containing lensoidal melanosomes of hornblendite and rafts of pelitic metasediment. The metasediments are more prolific to the northwest of the hornblende-biotite gneiss unit. Both pelitic metasedimentary and hornblende gneiss units are cut by pegmatite and aplite dikes. The Grey Trout Road copper-nickel occurrence is hosted by a previously unrecorded anorthosite body of unknown extent. The contact between the anorthosite and the hornblende-biotite gniess appears to be sheared.

In the vicinity of the occurrence, gneissosity strikes 060° to 070°, and dips 60°NW. An elongate airborne magnetic anomaly trends northeasterly, indicating a discordance between locally measured trends and inferred trends from the airborne magnetic maps.

An EM survey conducted by J. Bolen and A. McCormick over the property has located 9 conductors with the conductor on the showing being one of the weakest. Conductors in the biotite gneiss unit are not as strong as those in the anorthositic unit and have a high magnetic profile. Conductors in the vicinity of the showing are stronger and have a low magnetic profile. Samples collected by M.R. Hailstone of sulphide mineralization associated with amphibole melanosomes within the biotite-hornblende gneiss gave the following results: 844 ppm Cu, 72 ppm Ni, 13 ppm Cr, 66 ppm Co and less than 10 ppb Pd (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt). An analysis of mineralization at the showing gave the following results: 14 620 ppm Cu, 1780 ppm Ni, 18 ppm Cr, 722 ppm Co, 46 ppb Pd (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt).

Mineralization at the showing occurs as massive fracture fillings and net textures around fracture fillings. Sulphide mineralization consists of chalcopyrite, pyrrhotite and pyrite, in order of abundance. A black magnetic mineral occurring as coarse-grained (0.5 cm diameter) disseminations is thought to be ilmenite: titanium assays to support this were not available at the time of writing. The exact nature of the mineralization at the showing was difficult to determine as much of the showing is under the roadbed. Samples collected by M.R. Hailstone from that part of the showing that is exposed were cut to examine the mode of occurrence of the sulphides. These samples showed fracture filling by sulphide to be the dominant mode of occurrence with wispy stringers being parallel to the fabric around vein boundaries.

The area has no recorded history of exploration; no other mineral occurrences are known and mapping is of the 1:126 720 reconnaissance-type scale (Sage et al. 1974). At least 1 other outcrop of anorthosite is known north of the Quetico fault along the Glenorchy—Manion Lake road, as is shown on the Ontario Geological Survey's Preliminary Map P.965 (Sage et al. 1974) and Map 2443 (Blackburn 1981), and there may be others. The anorthosite discussed here together with other as yet undiscovered anorthosite bodies within the southern margin of the Irene—Eltrut lakes batholithic complex may have potential for magmatic copper- nickel and platinum group element (PGE) ore deposits.

Lavender Lake Copper Occurrence

Copper and nickel were discovered in 1991 by G. Pogson, Prospector, at the le May—Code townships boundary, located 30 km southeast of Kenora (Figure 2.5). The property is accessed by the Witch Bay road off Highway 71. A 450 m long trail leads from the road to the most-westerly showings. G. Pogson has exposed mineralization in 11 pits and trenches over a strike length of approximately 400 m. Five of these are shown in Figure 2.5.

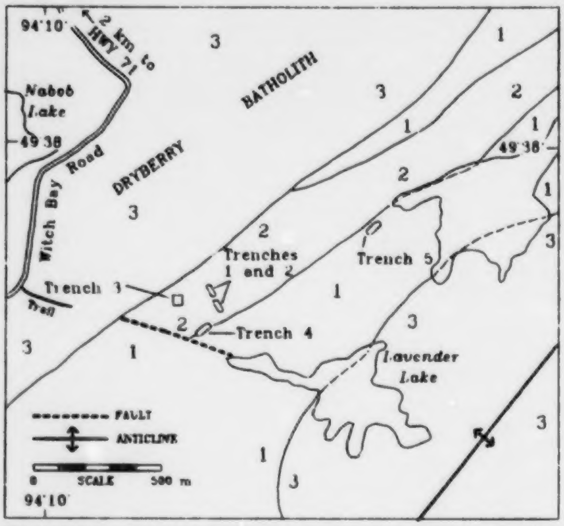


Figure 2.5. Lavender Lake copper occurrence: 1) mafic to intermediate metavolcanics; 2) mafic to ultramafic intrusive rocks; 3) granitic rocks. Geology after Trowell et al. (1987).

The general geology of the area is shown on the Ontario Geological Survey's Preliminary Map P.3076 (Trowell et al. 1987). The property is underlain by a northeast-trending, ultramafic to mafic sill in contact to the north with granitoid rocks of the Dryberry batholith and to the south with mafic metavolcanics of the Bigstone Bay group (Ayer et al. 1991). Although not indicated on Preliminary Map P.3076, the author (M.R. Hailstone) had observed 2 peridotite layers close to the southeastern margin of the predominantly gabbroic sill, indicating the sill to be differentiated to the northwest, in conformity with another sill along strike to the west-southwest. Subangular, 1 to 2 m sized blocks of peridotite derived from the southernmost layer occur within the gabbro just above the top of the layer. The sheared nature of the contact between the sill and the mafic volcanic flows is expressed by a 30 m wide topographic low between the units.

Mineralization within the sill appears to be associated with 0.5 m wide minor shears striking between 030° and 045° and G. Pogson has used this as a guide in his prospecting. Mineralization exposed by G. Pogson in trenches consists of chalcopyrite, pyrrhotite and minor pyrite. Chalcopyrite is the dominant sulphide mineral, occurring as massive fracture fillings and as a filling within 1 cm wide tension fractures related to the minor shears. However, mineralization in some of the trenches occurs as patches of net-textured sulphides and as sulphide blebs, strongly suggesting an initial magmatic component to the concentration process. Small patches of massive pyrrhotite give a positive reaction when tested for nickel content with dimethylglyoxime.

The best mineralization uncovered to date is in 2 trenches opened up in gabbro by G. Pogson on the crest of a hill 20 m north of the southern peridotite layer (*see* Figure 2.5, trenches 1 and 2). Grab samples taken by the Staff Geologist from these trenches gave the following results on analysis: 14 980 ppm Cu, 64 ppm Ni, 42 ppm Co, less than 10 ppb Pd and 0.002 ounce Au per ton from the north trench; and 9500 ppm Cu, 288 ppm Ni, 159 ppm Co, less than 10 ppb Pd and 0.002 ounce Au per ton from the south trench (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt).

A third trench approximately 200 m to the west of these 2 trenches (*see* Figure 2.5, trench 3) exposes massive tremolite with magnetite layers that define the primary attitude of the sill. The layers strike 060° and dip 55°NW. Discrete 2 cm thick layers of up to 1% disseminated pyrite are also present. A cumulative grab sample taken by M.R. Hailstone from this trench primarily for PGEs gave the following results on analysis: 80 ppm Cu, 343 ppm Ni, 103 ppm Co, 388 ppm Cr, less than 10 ppb Pd and nil Au (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt).

A fourth trench approximately 100 m south of the 2 trenches on the hill (*see* Figure 2.5, trench 4) has exposed a 070° trending, silicified shear zone within the gabbro, 5 m north of the southern peridotite layer. This trench is within 25 m of a northwest-trending fault that terminates the differentiated sill. Sulphide mineralization consists of up to 5% combined pyrite and chalcopyrite as disseminations, laminations and patches. No pyrrhotite is present. A blue-grey mineral that may be galena or molybdenite was observed in a 2 to 3 mm wide lamination within the shear. A grab sample taken by the author from this trench primarily to evaluate it for gold gave the following results on analysis: 15 240 ppm Cu, 166 ppm Ni, 166 ppm Co, 16 ppm Cr, 75 ppm Sb, 89 ppm Zn, 56 ppm Pb, 40 ppm Bi, 602 ppm Mo, trace Au and trace Ag (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt).

A fifth trench (*see* Figure 2.5, trench 5), which is within the mafic metavolcanics and located 700 m to the east of the 2 trenches on the hill, exposes two 1 m wide sulphide-bearing shears separated by 2 m of barren mafic-flow material. The shears contain siliceous, tourmaline- and graphite-bearing knots and laminations with 1% to 2% chalcopyrite, pyrite and pyrrhotite. These shears may have followed the original interflow-sediment layers. The shear zones strike 060°, parallel to the strike of the sill, and are 30 m south of the sheared contact between the sill and the mafic volcanics. Grab samples taken by the author primarily to test for possible volcanogenic-sulphide concentration gave the following results on analysis: 1735 ppm Cu, 410 ppm Zn, 207 ppm Co, less than 10 ppm Pb and trace Au from the north shear; and 1120 ppm Cu, 27 ppm Zn, 59 ppm Co, less than 10 ppm Pb and trace Au from the south shear (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt).

In addition to its potential as a copper-nickel prospect, the property may be valuable for 2 other commodities. The massive tremolite may be of value as a carving stone. The tremolite is massive, 5 to 10 m thick and at minimum 200 m long, though further prospecting is required to fully delineate its extent. Secondly, 1 to 2 m thick, flat-lying quartz veins occur in the sill within 10 m of the contact with the Dryberry batholith. These may have some potential as crushed quartz aggregate for decorative purposes. The veins are pure white and massive and do not appear to contain any sulphides. The environment is similar to that of quartz veins currently being exploited for decorative stone by Crystal Quarries Ltd. at the contact between the Mulcahy gabbro and the Atikwa batholith southwest of Eagle Lake (*see* "Mining Activity" section, this report).

In summary, the potential of this property as a magmatic-sulphide occurrence suggests that differentiated sills north and west of Gibi Lake should be prospected for copper, nickel and PGEs. Furthermore, silicified shears should be prospected for gold, since the environment is similar to that of the largest past producer of gold in the Kenora Resident Geologist's District—the Wendigo Mine, 7 km to the southwest.

BASE AND PRECIOUS METALS IN THE SEPARATION LAKE GREENSTONE BELT

Introduction

Interest in the mineral potential of the Separation Lake greenstone belt (Figure 2.6), 55 km north of Kenora, has increased in the last few years, because it is one of the last few such belts that has not undergone repeated exploration. This lack of previous work would appear to be due to 2 factors: the belt is situated well within a gneissic terrane, where it is metamorphosed to high-metamorphic grades, and such terranes have in the past been considered poor-prospecting areas; the belt has been difficult to access compared to the well-established network of roads which occur, for example, in the granite-greenstone Wabigoon Subprovince to the south. The discovery of metallic minerals in high-metamorphic grade terranes elsewhere, coupled with the improvement in access due to construction of forest-access roads, makes the belt worthy of further consideration.

Mainly because of the ongoing activity of 1 company, Champion Bear Resources Ltd., the Resident Geologist has visited various parts of the belt since about 1987, but particularly so in 1990 and 1991 when the company was agressively exploring the western end of the belt in the vicinity of Umfreville and Separation lakes. In 1991, reconnaissance of regional geology was made from Umfreville Lake, the English River road and its sideroads.

General Geology

The Separation Lake greenstone belt has been mapped at a reconnaissance scale only (Breaks et al. 1975a, 1975b) during a helicopter-supported regional-mapping program conducted between 1973 and 1976 (Breaks et al. 1978). This program covered a large part of the gneissic region between the Wabigoon and Uchi granite-greenstone subprovinces. More recently, the gneissic region has been divided into 2 subprovinces: a northern supracrustal sedimentary terrane, the English River Subprovince; and a southern intrusive- and gneissic-granitoid region, the Winnipeg River Subprovince (Card and Ciesielski 1986). The Separation Lake greenstone belt lies along the boundary between the 2 subprovinces at their western end. In the 1988 field season, M. Sanborn-Barrie studied the boundary zone, from the Manitoba border in the west to the eastern end of Lac Seul in the east, and briefly discussed the general geology of the Separation Lake greenstone belt (Sanborn-Barrie 1988); that author concluded that the boundary between the 2 subprovinces lies at the northern margin of the metavolcanic belt.

The belt is about 50 km long by 5 km wide. Mafic metavolcanics predominate and contain interbedded oxide- and silicate-facies iron formations, particularly in the vicinity of Separation Lake itself. Intermediate and felsic volcanics are subordinate and generally occur along the northern margin of the belt; however, their distribution is not well understood and they may be crucial in exploration for metallic minerals. Recent observations by geologists L.C. Chastko of Independent Exploration Services Ltd. and A.P. Pryslak, consultant to Champion Bear Resources Ltd., led them to conclude that much of the felsic plutonic-looking rock immediately adjacent to the mafic volcanic contact is in fact felsic volcanic rock at high-metamorphic grade. A mafic to felsic transition may, therefore, occur along a strike length—when measured around a major Z fold starting at the east end of Umfreville Lake and proceeding thence to Separation Lake—which is on the order of 30 km. Farther east along the same contact, a polymictic conglomerate marks the transition from the Winnipeg River Subprovince into the English River Subprovince, but its strike length is at present unknown.

Breaks et al. (1975a, 1975b) mapped an extensive area of migmatite adjoining the north side of the belt to which they gave the name inhomogeneous diatexite, a term that connotes almost complete melting of the pre-existing sedimentary or volcanic rocks during high-grade metamorphism. Where observed by the author along that portion of the English River which cuts across the greenstone belt, various transitions are present. These transitions include those ranging from a migmatite, characterized by quartz-feldspar-biotite paleosome and white granitic neosome, to a completely remobilized, coarse-grained, homogeneous diatexite of similar composition, with biotite-quartz segregations and very coarse-grained pegmatitic phases. Farther out into the English River Subprovince, there are massive pink granitoid rocks, mapped by Breaks et al. (1975a, 1975b) as quartz monzonite, which are crosscut by pegmatites of similar composition.

Mineral Exploration

Record of exploration both in the Separation Lake greenstone belt and in adjacent granitic and gneissic rocks extends back to the 1940s when A. Gauthier discovered gold, along with zinc and other base metals, at Umfreville Lake (former-

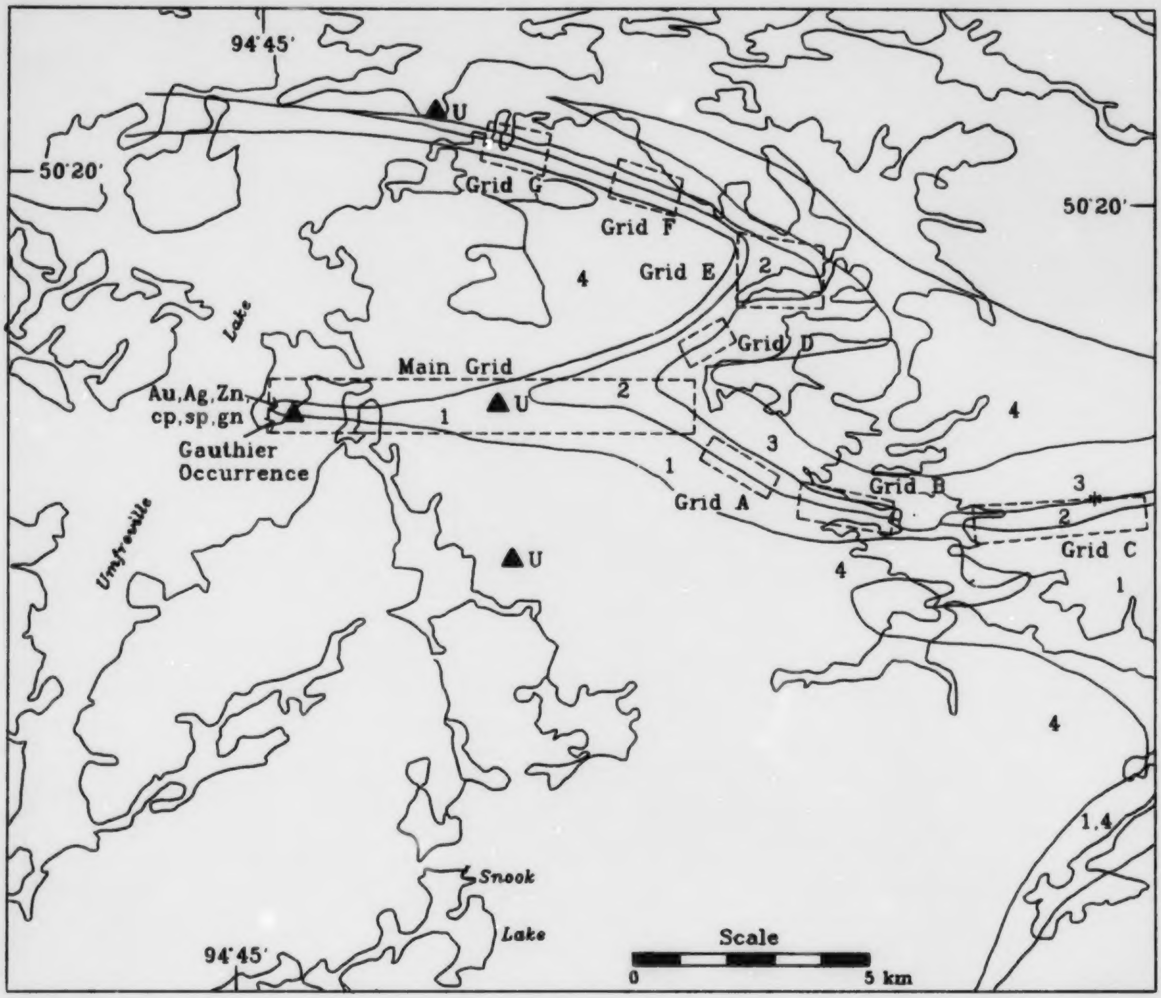


Figure 2.6. Separation Lake greenstone belt: general geology, mineral occurences and recent exploration. Figure shows Main grid and grids A to G of Champion Bear Resources Ltd. Legend: lithology, mineral symbols – (1) mafic metavolcanics, (2) felsic to intermediate metavolcanics, (3) migmatites, (4) granitoid rocks, (*) conglomerate, Ag–silver, Au–gold, cp–chalcopyrite, gf–graphite, gn–galena, IF–iron formation, sp–sphalerite, U–uranium, Zn–zinc. Geology *modified after* Breaks et al. (1975a, 1975b), Sanborn-Barrie (1988). Revisions by C.E. Blackburn.

ly Oneman Lake). Gold was also discovered at Helder Lake at the eastern end of the belt during this time. In the period 1948 to 1959, studies were done by W.S. Moore Company of Duluth, Tombill-Glen Echo Mines and Centurion Mines of the iron potential of the formation outcropping sporadically along the belt in the vicinity of Separation Lake. From 1968 to 1976, uranium was explored for by Can-Fer Mines Limited, Consolidated Summit Mines Ltd. and Noranda Mines Ltd. at the eastern end of Umfreville Lake, and uranium was also discovered near Treelined Lake, in proximity to graphitic rocks that were investigated in 1988 by Bellwether Resources Ltd. Base metal exploration was carried out in the 1970s, mostly from a reconnaissance standpoint, by Selco Mining Corporation Limited and Sherritt Gordon Mines Limited (Breaks et al. 1975a, 1975b); however, there is no record of this work in the assessment files at the Kenora Resident Geologist's office.

In 1985, the Gauthier occurrence at Umfreville Lake was examined by Sparton Resources Inc. for both gold and base metal potential. In 1988—following the discovery by M. Thorburn of Kenora of a single, loose piece of high-grade, chalcopyrite-bearing "float" beside the English River road approximately 2 km north of the Separation Lake bridge—Noranda Inc. did lithogeochemical and soil geochemical surveys in the immediate area but then subsequently dropped the option. In 1987, Shabu Gold Mines Ltd. began a program of exploration for gold at Helder Lake that has been continued by Champion Bear Resources Ltd. under the direction of Independent Exploration Services Ltd. Following an airborne geophysical survey and drilling program in 1988 at Helder Lake, the company extended its claim holdings westward along the belt for a distance of 45 km to the Gauthier occurrence and conducted an airborne survey over the additional claims in 1989. Field work in

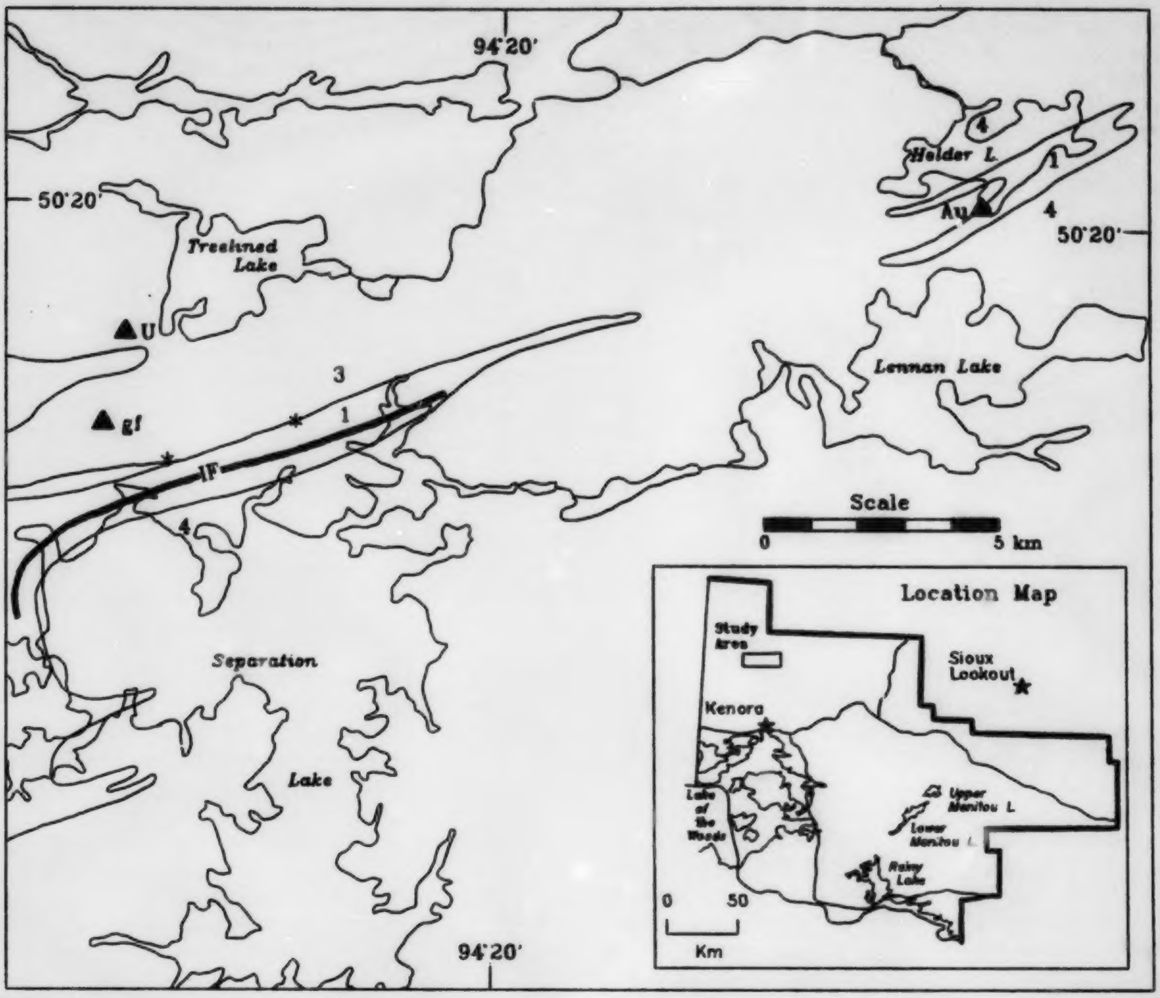

94°20'
50°20'
Treelined Lake
U
gf
3
1
IF
4
Separation Lake
Helder L.
4
1
Au
4
50°20'
Lennan Lake
Scale
0
5 km
Location Map
Study Area
Sioux Lookout
Kenora
Lake of the Woods
Upper Manitou L
Lower Manitou L
Rainy Lake
0
50
Km
94°20'

Figure 2.6. Continued, eastern half.

1989 was concentrated on the Gauthier occurrence which was stripped and sampled, and the company reported (Champion Bear Resources Ltd., press release, September 5, 1989) that continuous mineralization had been traced over a strike length of more than 1000 m and a width of 100 m. Furthermore, the company reported that assay values from grab samples were up to 0.70 ounce Au per ton, 1.87 ounces Ag per ton and 4% Zn. Exploration continued over a strike length of 10 km to the east from the Gauthier occurrence in 1990, thus, attempting to trace the zone along strike. However, it was realized that the zone was not traceable and that the occurrences which had been most recently investigated were in a different geologic setting. The program continued into 1991 (*see* discussion Umfreville—Treelined Lakes Area *in* section "Exploration Activity", this report) with drilling occurring at both the Gauthier occurrence and elsewhere to test the new targets. Having outlined further base metal targets from geophysical surveys, the company conducted geological mapping, trenching and sampling over these targets. These targets are spread either along or close to the contact between mafic metavolcanics, to the south, and inferred felsic metavolcanics, to the north.

Champion Bear Grids (Main and A to G)

During the 1991 field season, the author visited Champion Bear Resources Ltd.'s property between Umfreville and Separation lakes a number of times in the company of L. Chastko of Independent Exploration Services Ltd. and T. Pryslak. The emphasis of Champion Bear Resources Ltd.'s program in 1991 was placed on the east end of their Main grid, and on grids A through G; that is, the emphasis was placed on the base metal potential along the contact between mafic metavolcanics to the south and felsic metavolcanics to the north. The author is indebted to T. Pryslak and L. Chastko for their enthusiastic guidance to the geology of the property, however, the author's interpretation may differ in detail from theirs.

Grids were established on the basis of anomalies detected by the airborne electromagnetic and magnetic survey flown for the company in 1989. Ground electromagnetic anomalies have been identified on all grids and some of these have been tested by the 18 hole diamond-drill program conducted in early 1991. Many conductors remain to be tested, and numerous zones were stripped and trenched in 1991 in preparation for a drilling program to be commenced in 1992.

Mafic volcanics comprise both pillowed and massive flows metamorphosed to amphibolite facies, and in places these flows contain garnet. Degree of deformation increases toward the northern contact with the felsic rocks; in addition, along the contact a strongly foliated amphibolite with mafic and leucocratic bands, interpreted by the author to be highly flattened pillow lavas or pillow breccias, were observed on grids B and C.

Felsic rocks that lie adjacent to the mafic volcanic contact or that are in places interbanded with mafic units are of a number of different types; nonetheless, the differences are transitional and subtle. Away from the mafic contact, they grade or pass abruptly into gneisses of the English River Subprovince; in many places the transition is imperceptible. The felsic unit is on the order of 300 to 500 m wide on average where it has been mapped. The felsic unit's rocks vary from fine grained, strongly foliated or schistose, as typically is the case on grids B and C, through fine-grained, massive phases to a medium- to coarse-grained rock with clots of garnet and sillimanite or biotite. This latter phase, observed typically on grid G at the northwest end of the property, commonly contains mafic inclusions and pegmatitic phases indicating partial melting and assimilation.

Polymictic conglomerate containing mafic to felsic volcanic clasts, chert and granitoid clasts outcrops along the Umfreville road just north of grid C, and it marks the boundary between the volcanics of the Winnipeg River Subprovince and the migmatites of the English River Subprovince.

Sulphide zones account for most of the anomalies where exposed or drill tested to date. The author has observed sulphide zones on grids B, C and G, and on the Main grid. The sulphide zones occur predominantly in the mafic metavolcanics but also occur in the felsic rocks where they immediately adjoin the mafic metavolcanics to the north. These sulphide zones are, for the most part, parallel to the regional foliation which also parallels the contact between these 2 major units. Individual zones vary from being massive to disseminated and from containing barren pyrite-pyrrhotite to containing chalcopyrite which is either intimately mixed with the barren sulphides or disposed within late fractures. Additionally, zones with chalcopyrite and sphalerite may exist and they invariably occur in late fractures that crosscut foliation where present. In places, the sulphide zones are layered with interlayers of cherty rock which are on the order of 5 cm in thickness, and in some cases the layering is highly folded, as was seen, for example, on grid B. At 1 location on the Main grid approximately 1000 m south of the mafic-felsic contact, massive pyrite and pyrrhotite occur with garnet in a silicified mafic volcanic host along strike from a garnet-sillimanite schist; however, a sample taken by the author from this zone returned low ppm values for Cu and Zn on analysis (Temiskaming Testing Laboratory, Mines and Minerals Division, Cobalt). On grid G, pitting and trenching has been done on a massive-pyrrhotite zone in which is also found a quartz-feldspar-garnet-graphite rock that has been heavily weathered producing a white, powdery mineral; furthermore, this mineral was identified by X-ray powder diffraction to be a hydrous iron sulphate with a composition close to rozenite but transitional to boyelite—a hydrous zinc sulphate (Geoscience Laboratories Section, Mines and Minerals Division, Toronto). Samples have returned anomalous zinc values on analysis (A.P. Pryslak, personal communication, 1991).

In addition to the magnetite-rich iron formations at Separation Lake, other more siliceous units are interbedded with mafic metavolcanics in the vicinity of the English River road on the southern part of the C grid. They are characterized by both chert bands with minor magnetite and green amphibole bands. Minor amounts of sulphide minerals are also present. T. Pryslak (personal communication, 1991) suggests that there may be an upward progression from the magnetite-rich iron formations in the volcanic succession through the cherty units with minor magnetite and sulphides into the sulphide zones lying close to the transition into felsic volcanics.

As noted in the discussion entitled Umfreville-Treelined Lakes Area (*in* section "Exploration Activity", this report), Champion Bear Resources Ltd. consistently obtained anomalous to low copper and zinc values in drill holes; moreover, this pattern has been repeated in the sampling of sulphide zones trenched on surface (L. Chastko, personal communication, 1991). Nine samples taken by the Resident Geologist from a variety of sulphide zones on the property gave the following ranges on analysis: 37 to 837 ppm Cu, 27 to 3280 ppm Zn, less than 10 to 138 ppm Ni, 14 to 115 ppm Co, less than 10 ppm As, nil to 0.008 ounce Au per ton and nil to trace Ag. These results confirm both a negative precious-metals correlation and an absence of arsenic when compared to the association found at the Gauthier polymetallic occurrence at Umfreville Lake.

Helder Lake Sulphide Zone

The author briefly visited the Helder Lake sulphide zone accompanied by L. Chastko in 1989 but has spent no time assessing the regional geology. The geology in the immediate vicinity of the zone consists of a chert-magnetite iron formation occurring in a sequence of felsic to intermediate pyroclastic rocks ranging from tuffs to tuff breccias. The unit is about 20 m wide and appears to lie within amphibolite, as was mapped by geologists of Independent Exploration Services Ltd. (assessment files, Resident Geologist's office, Kenora). Strike is consistently to the northeast; however, the extent of this unit is unclear, as is the extent of the enclosing amphibolite. The amphibolites appear to be enclosed within granitic rocks and gneisses, close to or at the Winnipeg River—English River subprovinces boundary. Sulphides associated with the iron formation are pyrite, pyrrhotite, arsenopyrite, and minor chalcopyrite and sphalerite. Surface sampling and sampling of diamond-drill core by Independent Exploration Services Ltd. indicates anomalous gold values, but some values lie in the range of 0.2 to 0.5 ounce Au per ton (assessment files, Resident Geologist's office, Kenora).

Gauthier (Oneman Lake) Occurrence

As at the Helder Lake Sulphide Zone, the author briefly visited the Gauthier polymetallic occurrence in 1989 and again in 1990 but has spent no time assessing the regional geology. The arsenopyrite-rich, sulphide-bearing zone, which is on the order of 100 m wide, strikes in an easterly direction across a peninsula in Umfreville Lake, and it is contained within amphibolites that are the westernmost remnants of what appears to be an attenuated major fold of the Separation Lake greenstone belt. As at Helder Lake, the amphibolites are bounded on either side by granitic and gneissic rocks. The amphibolites are hornblende and biotite bearing, with minor amounts of garnet in places; consequently, the precursor rock is unclear to the author. Sulphides present—in addition to abundant arsenopyrite which can be on the order of 30% to 40%—are pyrite, pyrrhotite, sphalerite, and minor chalcopyrite and galena. Extensive surface and drill-hole sampling and assaying suggests that gold values are erratic but may be related to arsenopyrite content (assessment files, Resident Geologist's office, Kenora; L. Chastko, Independent Exploration Services Ltd., personal communication, 1989 and 1990). The relationship of sphalerite to both the other sulphides and the gold content is not clear. No magnetite iron formation has been observed at the Gauthier occurrence.

Conclusions

Gold and base metals have been found in anomalous to locally ore-grade amounts in the Separation Lake greenstone belt, but to date no deposits that approach commercially viable levels have been delineated. Controls on mineralization are obscured by metamorphic overprinting to the amphibolite facies but can be interpreted to some extent. Gold is present in sulphide zones that appear to be of 2 contrasting types: 1) pyrite-pyrrhotite dominated, with minor arsenopyrite, associated with chert-magnetite iron formation; and 2) arsenopyrite-rich, with lesser pyrite and pyrrhotite, and an absence of iron formation. Base metal occurrences are dominated by sphalerite, with minor chalcopyrite, and appear to have some stratigraphic control toward the top of the mafic volcanic succession. Neither arsenopyrite nor gold are dominant in these occurrences, suggesting that the concentrating process was distinctly different from that at the gold occurrences. It remains to be demonstrated that the base metal occurrences are volcanogenic in origin, or that there is potential for large tonnage deposits; to date, no mappable areas of alteration mineral assemblages, characteristic of such deposits, have been outlined, though very local concentrations of minerals such as garnet, sillimanite and graphite do indicate hydrothermal activity. However, the regional geology of the belt is not well understood, and exploration to date has been largely fragmentary. Recent increased ease-of-access by roads makes this belt a prime target for further prospecting and exploration.

GEOLOGICAL-DATA COMPILATION

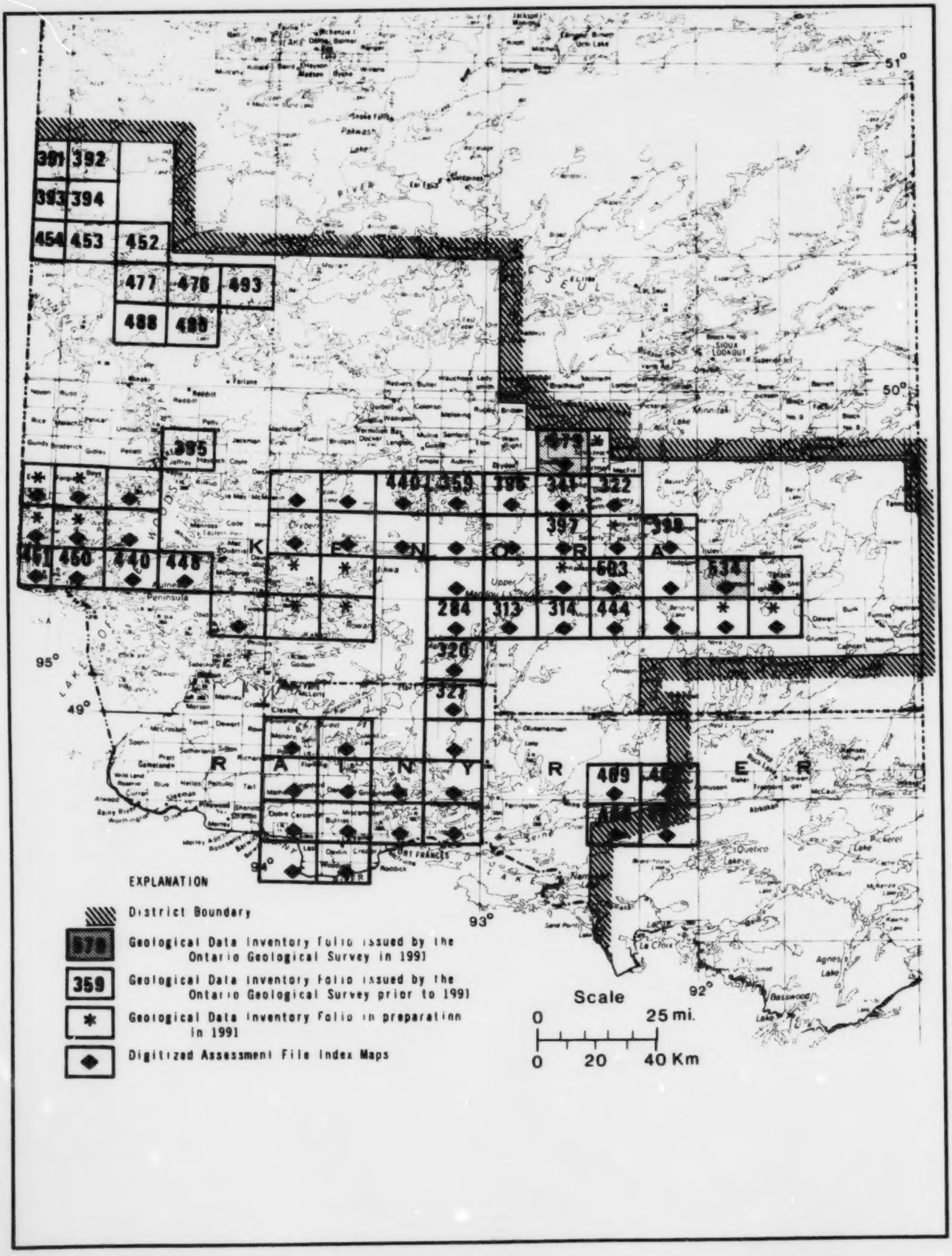
There were several geological-data-compilation activities in the Kenora office during the year.

A comprehensive compilation of 1113 mineral deposits in the Kenora Resident Geologist's District into a data base called Mineral Deposit Inventory (MDI) was completed in April, 1991, by the contractor Double Rainbow Exploration Services Inc. (DRESI). This data will become part of a computerized, province-wide data base for geoscience exploration, the Geoscience Exploration Database (GED).

The Assessment File Index Maps in the Kenora office are being digitized using AutoCAD®. At the end of 1991, 58 had been completed with 55 of them having been printed and put into use in the public area. At the present time, the paper copies are manually updated and, later, the changes will be entered into the computer and a new copy shall then be printed. These maps present the data in the same format as occurs in the Kenora Assessment File Database—a computer-generated and maintained index which has been available as a hard copy or on floppy disk on an on-demand basis since 1989. Printouts from the data base can be utilized with the digital maps, and both products can be made available on demand.

Compilation of Geological Data Inventory Folios (GDIFs) was for the most part superseded by the digitization of Assessment File Index Maps. Thirty-seven GDIFs have been published to date; in addition, another 9 are unpublished but available for viewing, and 4 more are in preparation. One of the unpublished GDIFs, the Shoal Lake area, and the other 4 in preparation are to be entirely computer generated. Once the Assessment File Index Maps have been completely digitized, they will be used as a base for new compilation products and these will be more flexible than the GDIFs. The recently compiled MDI data base will be a component of these new products.

Currently available GDIFs, including those unpublished or in preparation, and currently digitized Assessment File Index Maps are indicated in Figure 2.7.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489
K E N O R A
R A I N Y R I V E R
51°
50°
95°
49°
94°
93°
92°
EXPLANATION
District Boundary
Geological Data Inventory Folio issued by the Ontario Geological Survey in 1991
359
Geological Data Inventory Folio issued by the Ontario Geological Survey prior to 1991
*
Geological Data Inventory Folio in preparation in 1991
◆
Digitized Assessment File Index Maps
Scale
0
25 mi.
0
20
40 Km

Figure 2.7. Kenora Resident Geologist's District: geological data compilation.

DRILL CORE STORAGE PROGRAM

The Kenora Drill Core Library serves 3 of the 6 Resident Geologists' districts in northwestern Ontario: Kenora, Sioux Lookout and Red Lake. The drill core stored here consists of entire drill holes from both exploration and mine-development drilling, incomplete drill core recovered from old drill sites and short samples of core submitted for credit under section 77 (6) of the former Mining Act. Under the new Mining Act proclaimed in June, 1991, assessment credit is available for drill core submissions, but the ability to be able to submit short pieces of core taken from the drill hole at wide intervals has been discontinued. The current content of the library consists of 61 352.4 m of drill core stored inside the building and a further 23 798.4 m of drill core stored on pallets in secure outdoor storage for a total of 85 150.8 m. Drill core in outdoor storage consists of excess drill core from several drilling projects, that were collected in their entirety, and drill core removed from inside the building when core in better condition became available. All assessment-credit drill core from all 3 districts is now stored at the Kenora Drill Core Library.

For all 3 districts, a total of 5024.7 m of drill core from 115 drill holes was added to the collection between November 20, 1990, and the end of 1991. Of this, 4198.5 m of core from 77 drill holes came from the Kenora Resident Geologist's District. The library holds 48 544.4 m of drill core from 609 drill holes in the Kenora Resident Geologist's District; namely, 33 867.6 m (476 holes) inside the building and 14 676.8 m (133 holes) in outdoor storage. Drill core in outdoor storage consists of excess drill core from several drilling projects that were collected in their entirety and drill core removed from inside the building when drill core in better condition became available.

There were 122 visitors to the Kenora Drill Core Library in 1991, up slightly from 107 visitors in 1990. A total of 38 man-days were spent by industry personnel examining and logging drill core, rock-sample suites and other materials. Several exploration geologists inquired about the use of stored pulps and rejects from previous-sampling programs. The continuing depressed state of the exploration industry in 1990 is responsible for the low-usage figures.

Gold remained the primary exploration target in all 3 districts, and most of the drill core collected during 1991 was from gold exploration. Drill core was recovered from 19 projects in the Kenora Resident Geologist's District (Table 2.4; *see* Figure 2.2). Of these, all but 4 were targeted on gold or combined gold and base metals.

Drill core from 2 projects targeted on base and precious metals in ultramafic and mafic intrusions was retrieved during 1991. All 7 holes drilled by Mimiska Mining Company Inc. at the Nabish Lake copper-nickel occurrence south of Dryden (discussed under the section "Exploration Activity", this report) had their drill core collected. Copper-nickel exploration has a long history in the Rex Lake and Werner Lake areas. In 1987, interest in platinum group elements led Falconbridge Nickel Mines Ltd. to drill 4 holes on claims optioned from R.J. Fairservice, and the drill core from 2 holes was recovered in 1991.

Scramble Mining Company's gold property in Jaffray Township underwent surface and underground exploration between 1984 and 1989. Complete collections of drill core from holes drilled through the deposit, its host rock and mineralized sections were recovered. In 1988, Scramble Mining Company and Madeleine Mines Ltd. drilled 3 closely spaced holes on G. Pogson's Pipeline property in Haycock Township. Drill core representative of 1 hole was collected along with the Scramble property drill core.

Potential gold-bearing zones at the eastern end of Kakagi Lake have been explored several times. Drill core from the 1990—1991 winter drilling program by Rio Algom Exploration Inc. was collected. This drill core illustrates an extensive zone of highly altered pyroclastic and flow rocks. These holes augment drilling in the same rocks by Barrier Reef Resources in 1983 and Noranda Exploration Company, Ltd. in 1975.

Drill core from several gold exploration projects in the Lake of the Woods and Shoal Lake areas was collected during 1991 with collections coming from these programs: Noranda Exploration Company, Ltd. at Chisholm Island in 1990; B.P. Canada Inc. on the R.J. Fairservice property at Monument Bay in 1981; Rio Algom Exploration Co. Ltd. in

TABLE 2.4. Drill core collection sites, Kenora Resident Geologist's District.

1	Assin Partnership, Cygnet Lake (2 holes)
2	Assin Partnership, English River (1 hole)
3	Assin Partnership, Islington (2 holes)
4	Calnor Resouces Ltd. (Stephens, G.A.), Ewart Township (8 holes)
5	Champion Bear Resources Ltd., Helder Lake (5 holes)
6	Eurodollar Development Ltd., Wabigoon Lake (5 holes)
7	Exploration Brex—Mimiska Mining Company Inc, Nabish Lake property (7 holes)
8	Exploration Brex—Mimiska Mining Company Inc, Shoal Lake property (1 hole)
9	Fairservice, R.J., Monument Bay property (1 hole)
10	Fairservice, R.J., Rex Lake (Falconbridge Nickel Mines Ltd.) (2 holes)
11	Noranda Exploration Company Ltd., Chisholm Island (3 holes)
12	Palin Granite Canada Ltd., Direct Lake (2 holes)
13	Rio Algom Explorations Ltd., Ewart Tp. (1 hole)
14	Rio Algom Explorations Ltd., Kakagi Lake (4 holes)
15	Ross Island Resources Inc., Pipestone Lake (5 holes)
16	Scramble Mining—Boise Minerals Division, Scramble property Jaffray Township (26 holes)
17	Sheridan, J.P., (Scramble Mining Co.—Madeleine Mines Ltd.) Pogson property, Haycock Township (1 hole)
18	Wellington Cove Explorations Ltd, Vickers Lake (4 holes)
19	Zebruck, G., Gold Hill property, Bigtone Bay (2 holes)

Ewart Township in 1990; Calnor Resources Ltd.'s follow up drilling of 1987 and 1988 at High Lake which is in addition to that done in 1986 (already stored in the drill core library); and Mimiska Mining Company Inc. at Shoal Lake in 1991. These drill core from these holes represent continued exploration both on and near properties with a long exploration history. In late 1990, G. Zebruck drilled 2 holes to investigate 2 of the gold- bearing quartz veins on the old Gold Hill Mine site in Kirkup Township, one of the early gold producers of the Kenora area. Drill core obtained from both of these holes were added to the drill core library in 1991.

Drill core from the 1991 drilling program by Wellington Cove Explorations Ltd. which was undertaken at Vickers Lake (see section "Exploration Activity", this report) was collected in 1991. The drilling program was sited both on the old Smooth Rock Lake gold occurrence, on the west side of Vickers Lake, and on a new showing, the Angrove occurrence. Although gold assays were commonly low, the drill core is geologically interesting and indicates further gold and base metal potential.

Euro-dollar Development Ltd. carried out an extensive drilling program for gold and base metals under Wabigoon Lake in 1982. The drill core was finally located and collected in 1991. Unfortunately, part of this drill core had been destroyed, and the drill core and boxes from several more holes were so badly deteriorated that they were unrecoverable.

Ross Island Resources Inc. drilled a gold property on Pipestone Lake in 1989. The drill core recovered has several significant copper and zinc assays in altered metabasalt but only low gold values.

In recent years, drilling in the Winnipeg River Subprovince has been carried out for 2 widely differing commodity groups. Champion Bear Resources Ltd. has an ongoing exploration program directed at base and precious metals in highly metamorphosed volcanic and sedimentary rocks of the Separation Lake greenstone belt (*see* section "Base and Precious Metals in the Separation Lake Greenstone Belt," this report). Drill core drilled by the company at Helder Lake at the eastern end of the belt was recovered.

Granite is the second commodity; in pursuit of it, Palin Granite Canada Inc. and the Assin Partnership (a joint venture of several Indian Bands in the Kenora area) independently carried out diamond drilling projects on 4 granite deposits, and BQ size drill core from these projects is in storage in the library. The intent of these 2 projects was to evaluate colour and textural changes and to identify fractures. Drill core recovery was nearly 100%, but representatives of both companies expressed concern about the large amount of breakage of the drill core. Some of the fractures are clearly natural and some are clearly due to handling or drilling practices but a large number are ambiguous; however, the regular spacing of many of these fractures may indicate a pre-existing weakness in the granite. Drilling for fracture identification has not been favoured by many of the older dimension-stone-quarrying companies because they have found that it can give ambiguous results as is borne out in the present case.

TABLE 2.5. Maps and reports pertaining to the Kenora Resident Geologist's District issued by the Ontario Geological Survey and the Geological Survey of Canada, 1991

ONTARIO GEOLOGICAL SURVEY

Special Volumes

Special Volume 4 Geology of Ontario

Reports

GR 280 Precambrian geology, Clearwater Bay area.
GR 284 Precambrian geology, Manitou Stretch area.

Maps

Map 2549 Precambrian geology, Clearwater Bay area.
Map 2561 Precambrian geology, Manitou Stretch area.
Map 2554 Quaternary geology of Ontario, west-central sheet.
Map 2585 Shaded image of total magnetic field of Ontario, west-central sheet.
Map 2589 Vertical magnetic gradient of Ontario, west-central sheet.
Map 2593 Bouguer gravity of Ontario, west-central sheet.

Open File Reports

OFR 5750 A preliminary study of the magmatic evolution and geochronology of the Atikwa—Lawrence Volcanic-Plutonic Terrane.
OFR 5752 Geological history of the Sandybeach Lake area, Sioux Lookout—Dinorwic belt, Wabigoon Subprovince and its implications for gold exploration.
OFR 5769 Geology of the Dryberry Batholith Complex.
OFR 5773 Structural geology and tectonic history of eastern Lake of the Woods.
OFR 5794 Quaternary geology, Fort Frances—Rainy River area.
OFR 5804 Geology of the Falcon Island area.

RECOMMENDATIONS FOR EXPLORATION

Both activity in and results obtained from some prospecting and exploration programs conducted in 1991 in the Kenora Resident Geologist's District suggest possibilities for further work.

Teck Corporation has conducted an exploration program for gold in the vicinity of Thunder Lake, Zealand Township, since about 1990 (*see* discussion on "Manitou—Wabigoon—

TABLE 2.5. (continued)

Preliminary Maps

P 3169 Precambrian geology, Fornieri Bay—Hardrock Bay area.

Miscellaneous Papers

MP 152 Report of activities 1990, Resident Geologists.
MP 157 Summary of field work and other activities, 1991.

Geological Data Inventory Folios

GDIF 534 Raleigh Lake area 52 G/05 NW.
GDIF 579 Brownridge—Zealand townships 52 F/15 SE.

Studies

Study 56 Till sampling survey, Fort Frances area, results and interpretation.

Open File Map

OFM 174 Precambrian geology, Wild Potato Lake area.

GEOLOGICAL SURVEY OF CANADA

Open File Reports

Open File 2181 Regional lake sediment and water geochemical reconnaissance data, northwestern Ontario (52C).

Maps

Map 1770A Surficial geology, Rat Portage Bay.
Map 1771A Surficial geology, Northwest Angle.
Map 1772A Surficial geology, Blue Lake.
Map 1773A Surficial geology, Rowan Lake.
Map 1774A Surficial geology, Wabigoon Lake.
Map 1775A Surficial geology, Gold Rock.

Eagle Lakes Area" in section Exploration Activity, this report). The program has been conducted within an area mapped by Satterly (1943) as metasediments of the Thunder Lake sedimentary series, now considered identical to the Minnitaki group (Blackburn et al. 1991b). Traditionally, gold exploration in this area has been focussed on the metavolcanic rocks of the Neepawa group, which host the Goldlund gold-mining property, in Echo Township within the Sioux Lookout Resident Geologist's District, just east of the district boundary. Up to the present time, few gold occurrences have been discovered in the predominantly sedimentary Minnitaki group, though deposits are known to be associated with felsic-porphyry bodies at Minnitaki Lake. The recent discovery of gold by prospector F. Plomp (*see* discussion "Plomp Gold Occurrence" *in* section "Property Examinations", this report) within Thunder Lake metasediments farther to the west in Aubrey Township indicates that this is an environment that warrants further research. In particular, felsic-porphyry bodies that might have previously been misidentified as metasedimentary units, such as arkose, could be favourable hosts for gold. Such bodies may not be now easily identified where migmatization has occurred, particularly marginal to the Ghost Lake Batholith.

Western Troy Capital Resources Inc. has conducted an exploration program for gold in Menary Township which has been underway since about 1989; in 1991, gold mineralization was discovered in quartz veins within mafic metavolcanics close to the contact with granites of the Sabaskong batholith (*see* discussion "Fort Frances—Mine Centre Area" *in* section "Exploration Activity", this report). The Burditt Lake greenstone belt, of which this project area is a part of, has yielded few gold occurrences, however, gold-grain counts from overburden drilling and backhoe sampling both in this area and over a large area of the adjacent Rainy River lowlands to the southwest (Bajc 1988) indicate that the Burditt Lake belt could host significant gold deposits. The Burditt Lake greenstone belt has been mapped at a reconnaissance scale only (Blackburn 1975). The recently released results for all the elements analyzed in this study (Bajc 1991) offers a wealth of data for further research. It is significant to note that the recent discoveries by Western Troy Capital Resources Inc. are in a portion of the belt that shows little evidence of previous prospecting; indeed, visible gold grains stand out from the surface of weathered rock outcrops which clearly have never been previously sampled (Wayne Holmstead, Western Troy Capital Resources Inc., personal communication, 1991). The occurrence of these veins close to the granite contact suggests that the same contact around the margin of the Sabaskong batholith would be a good prospecting target.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

During the year, 1 field party from the Precambrian Geology Section operated within the Kenora Resident Geologist's District (Figure 2.8); specifically, B. Shanks conducted detailed mapping (1:15 840 scale) of the Wild Potato Lake area.

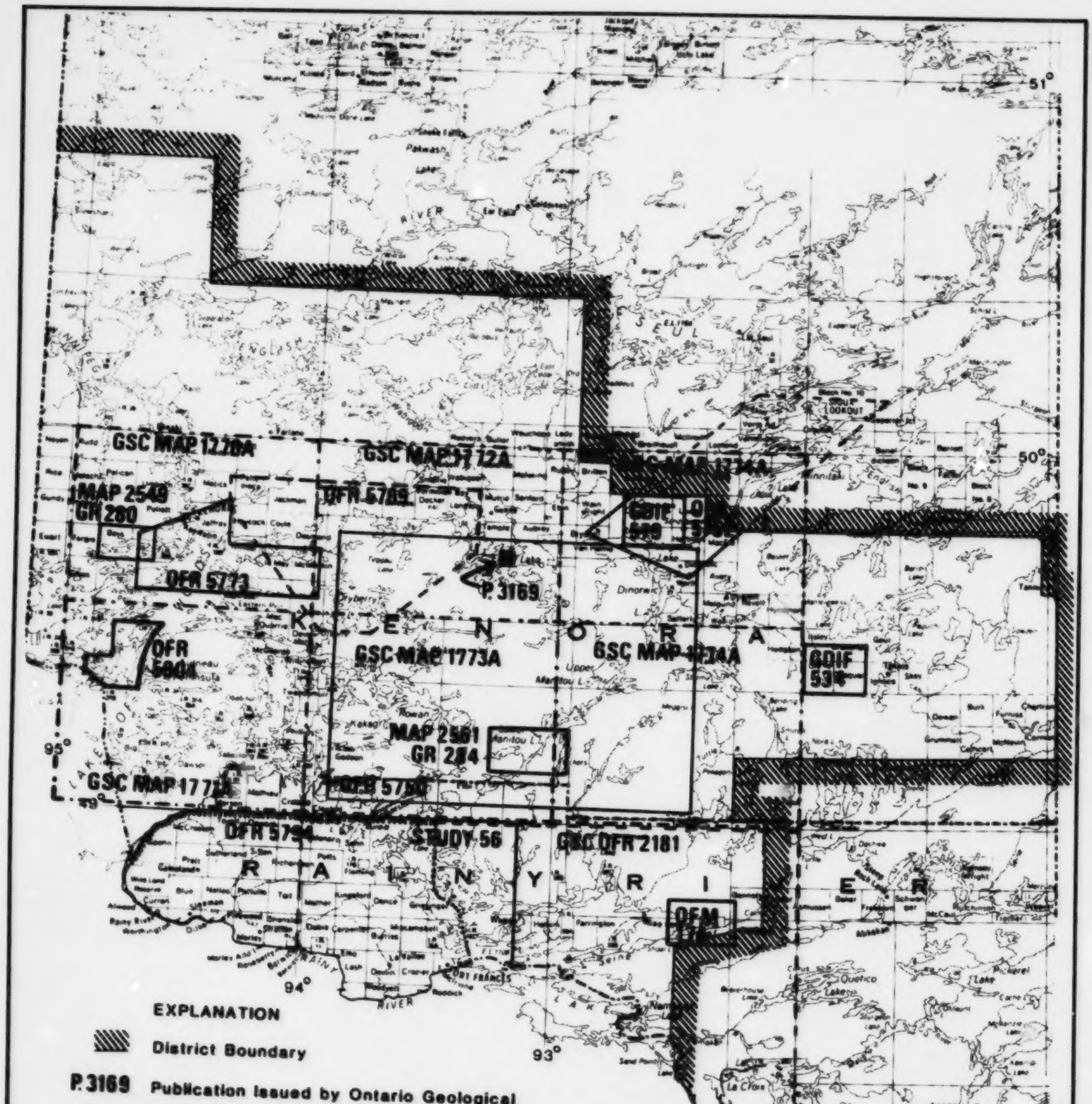
RESEARCH BY OTHER AGENCIES

University Theses

Geological-subject theses relating to the Kenora Mining Division believed to be in progress or completed during 1991, are as follows:

BSc THESES

C. Tarnocai studied alteration associated with a gold occurrence in Zealand and Hartman townships (Brock University, St. Catherines).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GR 280
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K E N O R A
GSC MAP 1773A
GSC MAP 1774A
GDIF
MAP 2561
GR 284
GSC MAP 1771A
STUDY 56
GSC OFR 2181
OFM
R A I N Y R I V E R
Dinorwic
Upper Manitou L.
Quetico
La Croix
EXPLANATION
District Boundary
P. 3169
Publication Issued by Ontario Geological Survey or Geological Survey of Canada (keyed to Table 5; Geology of Ontario Maps Cover Entire District and Are Not Shown on Map)
Scale
0
25 mi.
0
20
40 Km

Figure 2.8. Kenora Resident Geologist's District: publications.

MSc AND MA THESES

T. Warman completed and submitted his MSc thesis entitled *Sedimentology and history of deglaciation in the Dryden, Ontario area, and their bearing on the history of Lake Agassiz* (University of Manitoba, Winnipeg, Manitoba).

J. Debeer began a study of the volcanology of the Mine Centre volcanic belt (University of Minnesota, St. Paul, Minnesota, USA).

G. Clark continued a study of the gold-mining history in the Lake of the Woods area toward an MA degree (University of Manitoba, Winnipeg, Manitoba). A preliminary draft entitled *Lake of the Woods Gold Mining* is on file in the Resident Geologist's office, Kenora.

PhD THESES

J.A. Ayer began a study of the petrogenesis of volcanic and plutonic suites of the Lake of the Woods greenstone belt, and a comparison with those of other belts in the western Wabigoon Subprovince, utilizing trace elements and Nd-Sm and Rb-Sr isotope systematics (University of Ottawa, Ottawa).

SELECTED PUBLICATIONS RECEIVED DURING 1991

Ayres, L.D., Halden, N.M. and Ziehlke, D.V. 1991. The Aulneau Batholith: Archean diapirism preceded by coalescence of granitoid magma at depth; Precambrian Research, v.51, p.27-50.

Beakhouse, G.T. and McNutt, R.H. 1991. Contrasting types of Late Archean plutonic rocks in northwestern Ontario: implications for crustal evolution in the Superior Province; Precambrian Research, v.49, p.141-165.

Davis, D.W. and Smith, P.M. 1991. Archean gold mineralization in the Wabigoon Subprovince, a product of crustal accretion: evidence from U-PB geochronology in the Lake of the Woods area, Superior Province, Canada; Journal of Geology, v.99, p.337-353.

Edwards, G.R. and Hodder, R.W. 1991. A semi-quantitative model for fractionation of rhyolite from rhyodacite in a compositionally altered Archean volcanic complex, Superior Province, Canada; Precambrian Research, v.50, p.49-67.

Frey, B.A. and Venzke, E.A. 1991. Archean drill core description and assay in Lake of the Woods County, Minnesota; Minnesota Department of Natural Resources, Division of Minerals, Report 278, 180p

Lawler, T.L. and Venzke, E.A. 1991. Aeromagnetic interpretation pseudo-geologic maps, with evaluation, in Lake of the Woods and Lake counties, Minnesota; Minnesota Department of Natural Resources, Division of Minerals, Report 290, 132p.

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3. Red Lake Resident Geologist's District—1991

B.T. Atkinson[1], J.R. Parker[2], L. Kosloski[3] and C.C. Storey[4]

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INTRODUCTION

Following last year's slight increase in exploration activity, 1991 activity shows a marked downturn. Diamond-drilling activity reached a low level not seen in the district since 1977. Both geophysical and geological surveys declined sharply as did the total amount of assessment work reported. Table 3.1 gives a year by year perspective of claim-staking activity and assessment work credits filed in the Red Lake District. The present year marked a change in the method of reporting assessment work credits from man days to dollar value, the result of changes in the Mining Act. To allow a direct comparison of 1991 statistics with previous years, dollar value assessment credits reported in Table 3.1 are converted to man days using a conversion factor of 22 dollars per man day.

In the district, there were 11 companies actively carrying out exploration programs. Exploration highlights include renewed base metal exploration in the South Bay Mine area by BHP-Utah Mines Ltd., Minnova Inc., Noranda Exploration Co. Ltd. and Rio Algom Exploration Inc.

Both Noranda and Placer Dome Inc. sought gold mineralization in several northern greenstone belts.

Teck Corporation continued exploration in the Dixie Lake area for gold and base metals.

Exploration activities known to have occurred in the district during 1991 are listed in Table 3.2. This table is keyed to Figure 3.1a and 3.1b.

In the district there were 5 Ontario Mineral Incentive Programs (OMIP) with a value of $100 331 and 13 Ontario Prospectors Assistance Program (OMIP) grants with a value of $129 580.

MINING ACTIVITIES

Placer Dome Inc.s' Campbell Mine and Dickenson Mines Limited's Arthur W. White Mine continued gold production as the only 2 mining operations in the district. Both mines are located in Balmer Township.

Placer Dome Inc.–Campbell Mine

Gold production at the Campbell Mine in 1990 amounted to 254 997 ounces from 431 851 tons of ore milled. Average ore grade was 0.59 ounce Au per ton.

Production figures for 1991 are projected to be 248 400 ounces gold from 427 000 tons of ore grading 0.62 ounce Au per ton.

Underground development work at the mine for the present year included 3840 m of drifting and 1375 m of raising. Ore definition diamond drilling was 18 700 m, and 14 000 m of exploration drilling was completed.

Mining operations continued on all ore zones, 54 of the 75 headings provided ore to the mill.

Exploration of the adjoining Craibbe-Fletcher Gold Mines Ltd.'s property was conducted from the 14th level of the Campbell Mine.

The installation of a pressure oxidation circuit to the mill complex was completed on schedule at a cost of $23.6 million. A new impoundment facility was constructed to receive tailings discharge from the pressure oxidation circuit. The circuit is presently treating 60 tons of gold concentrate daily and has a 75 ton per day capacity. Gold recovery from the pressure oxidation circuit is 99%. The on-site sulphide roaster was decommissioned after start up of the pressure oxidation circuit.

The mine employs 494 people.

Proven and probable ore reserves as of March, 1991, are 5.4 million tons with an average grade of 0.559 ounce Au per ton. T. Mann is the General Manager of the mine. (R. Church, J. Frostiak, Campbell Mine, personal communication, 1991).

Dickenson Mines Ltd.–Arthur W. White Mine

Gold production at the Arthur W. White Mine was 76 644 ounces from 284 506 tons of ore milled for 1990. In 1991, production figures are forecast to be 75 120 ounces gold from

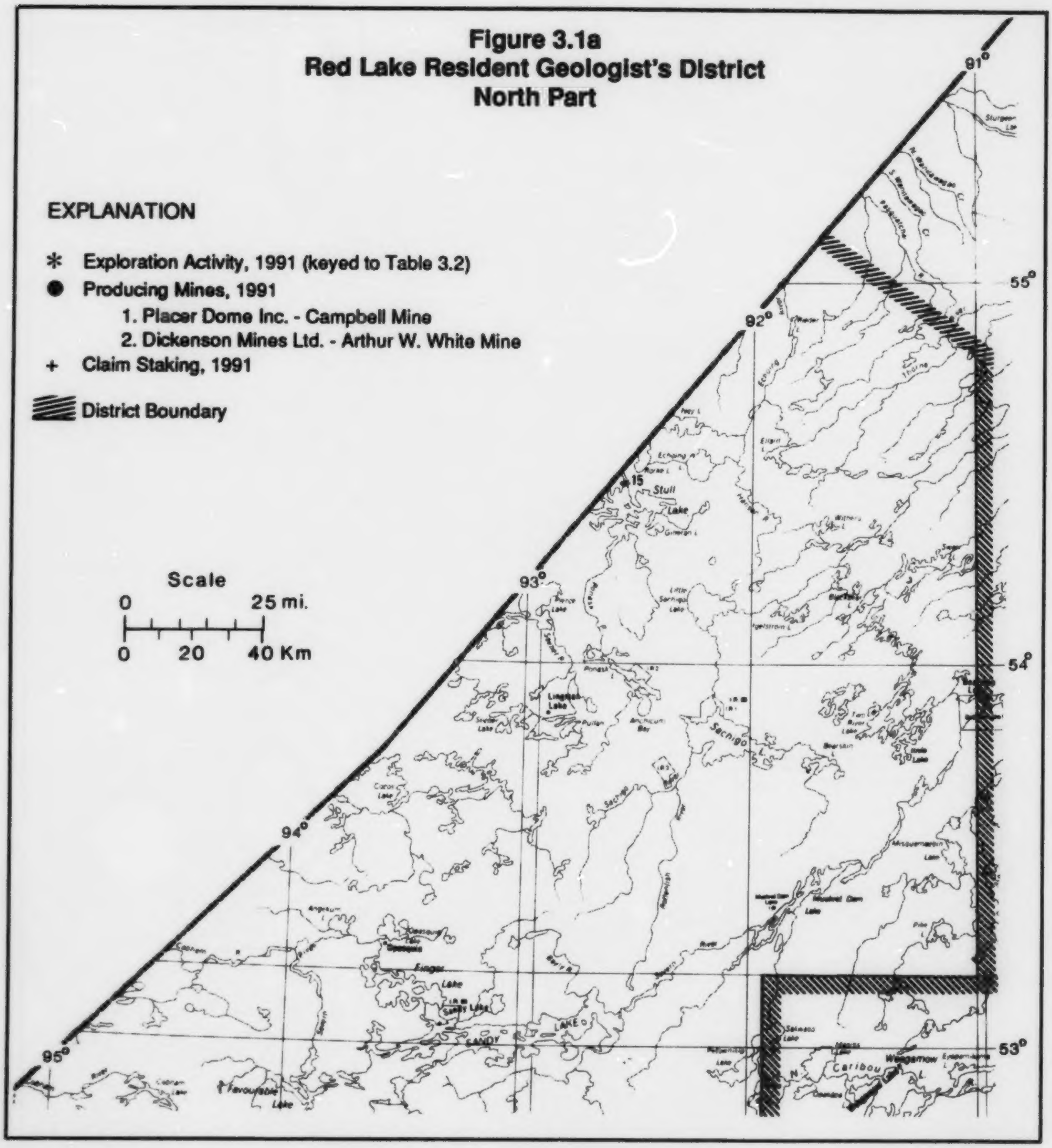


Figure 3.1a
Red Lake Resident Geologist's District
North Part

EXPLANATION
* Exploration Activity, 1991 (keyed to Table 3.2)
● Producing Mines, 1991
1. Placer Dome Inc. - Campbell Mine
2. Dickenson Mines Ltd. - Arthur W. White Mine
+ Claim Staking, 1991
▨ District Boundary
Scale
0
25 mi.
0
20
40 Km
91°
92°
93°
94°
95°
55°
54°
53°
15
Stull Lake
Echoing R.
Little Sachigo Lake
Sachigo L.
Finger Lake
Sandy Lake
SANDY LAKE
Favourable Lake
Muskrat Dam Lake
Caribou L.
Weagamow L.
Severn
River

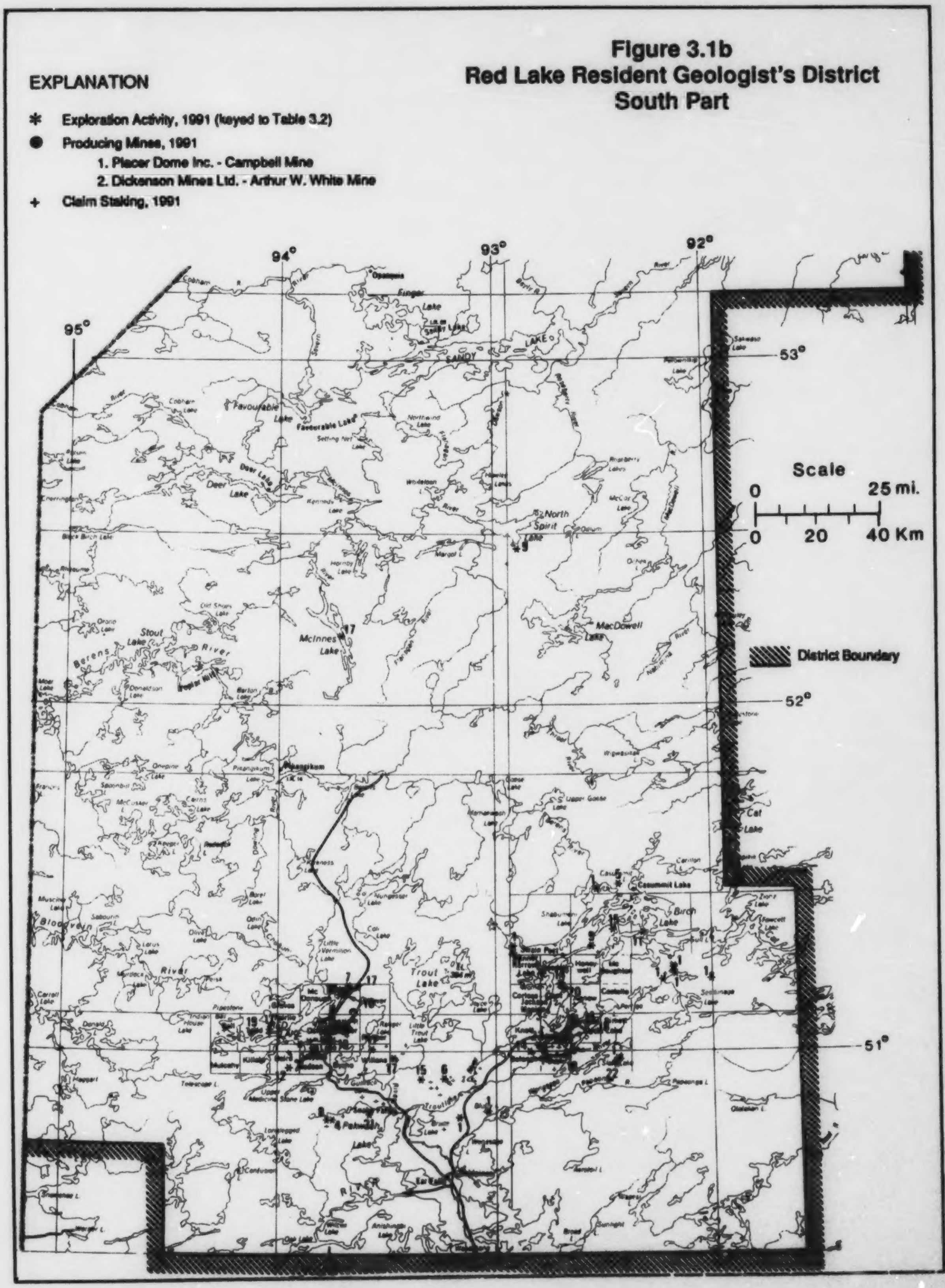


Figure 3.1b
Red Lake Resident Geologist's District
South Part

EXPLANATION
* Exploration Activity, 1991 (keyed to Table 3.2)
● Producing Mines, 1991
1. Placer Dome Inc. - Campbell Mine
2. Dickenson Mines Ltd. - Arthur W. White Mine
+ Claim Staking, 1991
Scale
0 25 mi.
0 20 40 Km
▨ District Boundary
95°
94°
93°
92°
53°
52°
51°
SANDY LAKE
Favourable Lake
Deer Lake
North Spirit Lake
McInnes Lake
MacDowell Lake
Stout Lake
Berens River
Bloodvein River
Trout Lake
Birch Lake
Cat Lake
Pikangikum
Confederation Lake

Table 3.1. Summary of claims recorded and assessment work credit.

Year Recorded	Claims Cancelled	Claims Active	Claims	Diamond Drilling	Geophysical Surveys	Geological Surveys	Total Man Days
1991	1146	2884	8106	18398.8	46796.8	1871	71591.46
1990	2264	3648	9844	39162	91499	7540	151384
1989	1841	1548	11228	61422	39814	8510	132620
1988	2286	2368	10935	175600	215300	42666	457500
1987	4512	1708	11017	81854	138443	23440	261741
1986	3803	1598	10427	48325	127445	6360	189633
1985	2673	2260	8212	42000	201052	16642	269262
1984	4344	1725	7799	32588	78538	12495	128664
1983	2407	1204	5180	18637	22035	3468	53207
1982	942	1884	3992	23967	79662	6787	118775
1981	1719	1249	4889	28771	66000	8182	107430
1980	2220	1115	4301	38482	30240	871	71975
1979	1068	1763	3221	21108	38380	3154	62949
1978	1207	1521	3916	25574	19496	2480	50997
1977	2324	2395	4261	12994	45080	620	59196
1976	2705	1382	4332	18680	23578	380	46544
1975	1368	2059	2957	29377	12714	960	44717
1974	1339	1829	3648	47362	5660	3040	57719
1973	1616	3157	4009	60027	20474	NIL	83019
1972	2219	5284	5588	34261	14858	5216	56173
1971	1541	4922	8486	73019	50920	2243	127556

313000 tons milled. Current milling rate is 950 tons per day. Gold recovery from the mill is 80%, sulphide concentrate is stockpiled at the mine site.

Underground drilling at the mine included 15 950 m of development drilling and 9400 m exploration drilling. Underground drifting amounted to 1270 m and an additional 900 m of ramping and 550 m raising was completed.

Surface exploration on the mine site included stripping, geological mapping and sampling north of the North C zone.

The mine employs a work force of 297.

Ore reserves in the proven and probable category as of December, 1991 amount to 3.2 million tons at a grade of 0.32 ounce Au per ton. The mineral inventory at the mine is 5.2 million tons at a grade of 0.31 ounce Au per ton. B. Bried is the Mine Manager. (J. Rogers, Arthur W. White Mine, personal communication, 1991).

ADVANCED EXPLORATION AND DEVELOPMENT

TVX Gold Inc.–Cochenour Willans Mine

The Wilanour project at the Cochenour Willans Mine in Dome Township was inactive during the year, mine workings continued to be dewatered and the mine is on a care and maintenance status.

An independent ore reserve study by Strathcona Mineral Services Ltd. indicated the Cochenour Willans mine contains 63 360 ounces of gold in proven and probable reserves (*Globe and Mail*, Nov. 16, 1991, p.B5).

McFinley Red Lake Mines Ltd.

The McFinley Mine property was inactive during the year, underground workings continued to be dewatered.

EXPLORATION ACTIVITY

Red Lake Greenstone Belt

Aur Resources Inc. completed line cutting, magnetic and electromagnetic surveys on 17 claims in the St. Paul Bay area in Fairlie, Dome, Baird and Heyson townships. Three holes were diamond drilled on the ice of St. Paul Bay totalling 678 m. One hole encountered ultramafic rocks through its entire length, a second hole retrieved the highest gold intersect of the drill program of 0.024 ounce Au per ton over 8.0 feet.

Placer Dome Inc. completed 30 km of line cutting, geological mapping and lithogeochemical sampling on their East Bay property in Bateman Township. The company also did 20 km of induced polarization surveys and diamond drilled 12 holes totalling 2275 m on the property.

On their Gullrock Lake property in Willans Township, Placer Dome Inc. did 53 km of line cutting, magnetic and electromagnetic surveys.

Placer Dome Inc. staked 105 claims in Baird, Fairlie and Todd townships comprising their Martin Bay property. On the north part of the claim group the company did 122 km of line cutting, geological mapping, lithogeochemical sampling, magnetic and electromagnetic surveys.

On their Sobel Lake property in the Otter Lake and South of Otter Lake area, the company did 66.4 km of line cutting, 187 km of magnetic and electromagnetic surveys and geological mapping. A diamond-drill program of 13 holes totalling 2177 m tested the Sobel Lake property.

Madsen Gold Corp. continued to re-evaluate diamond drill logs, sections and mine plans from the Madsen Mine in Baird Township. Madsen has indicated geological reserves at the mine are 664 637 tons grading 0.21 ounce Au per ton. (*The Northern Miner*, Sept. 2, 1991, p.19). Many of the old mine buildings were torn down as clean-up and rehabilitation of the site continued during the year.

A number of OPAP funded prospecting programs were carried out by local Red Lake prospectors.

Dixie Lake Greenstone Belt

During the year Teck Corporation did 20 km of geological mapping, induced polarization surveys and diamond drilled 11 holes totalling 2000 m on their Dixie and Pakwash lakes properties.

Birch–Confederation–Uchi Greenstone Belt

To stimulate exploration and aid geological mapping, the entire Birch–Uchi–Confederation lakes greenstone belt was covered by airborne geophysical surveys. The product of these surveys included a set of 75 geophysical maps at a scale of 1:20 000 which were released in July, 1991. Coincident with the airborne surveys, quarter-mile scale geological mapping of the north part of the Birch Lake area was completed by the Ontario Geological Survey.

The airborne data release prompted a number of companies and individual prospectors to acquire claims in the area.

Asarco Exploration Co. of Canada Ltd. staked 17 claim groups totalling 110 claims covering geophysical targets identified by the airborne survey. Line cutting and ground geophysical surveys have been carried out over a number of these claims by Asarco.

BHP–Utah Mines Ltd. staked ground southwest of Fly Lake in Mitchell and Bowerman townships and did geological mapping, prospecting and lithogeochemical sampling.

Gold Fields Canadian Mining Ltd. flew an airborne survey comprising 276 km in the Casummit and Shabumeni lakes area.

Joutel Resources Limited flew an airborne geophysical survey over their claim group in the Satterly Lake area of Birch Lake.

Minnova Inc. holds 354 claims in the Confederation Lake area. The company completed 228 km of line cutting, 100 km of geophysical surveys, geological mapping and lithogeochemical sampling including 2000 samples on their claims. Six diamond-drill holes totalling 2700 m were completed by the company.

Noranda Exploration Co. Ltd. carried out exploration on a number of properties including the Dixie 3, 17, 18 and 19 massive sulphide deposits discovered by Selco Inc. in the early 1970's. Lithogeochemical sampling, borehole and surface geophysical surveys and diamond drilling of 4 holes totalling 1299 m were completed on these properties collectively referred to as the Dixie/Selco joint venture project.

Noranda did limited induced polarization, prospecting, trenching and sampling on their Horseshoe Island property in Birch Lake where St. Joe Canada Inc. outlined a gold inventory of 775 000 tonnes grading 0.13 ounce Au per tonne (*The Northern Miner*, Jan. 19, 1987, p.1). Magnetic surveys, prospecting and trenching was completed by Noranda on their Rice Bay property in Birch Lake.

Rio Algom Exploration Inc. held 56 claims on Fly Lake in Mitchell and Bowerman townships. During the year, 42 km of linecutting and lithogeochemical sampling was completed by the company.

Starmin Mining Inc. completed prospecting, trenching, mapping and sampling on their 25 claim Confederation Lake property in Dent Township.

Northern Greenstone Belts

Placer Dome Inc. completed 20 km of induced polarization surveys on their claims at McInnes Lake.

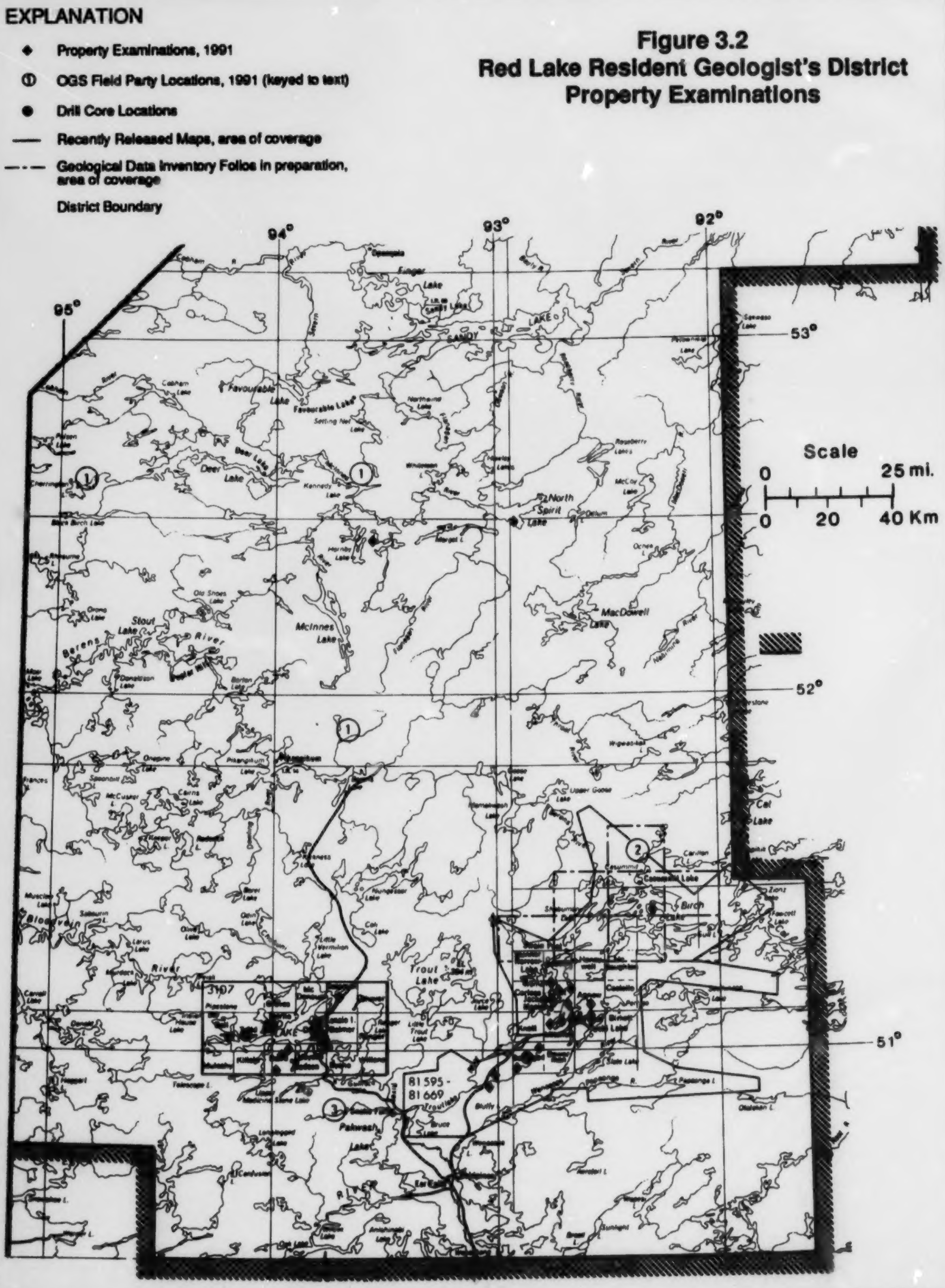
Noranda Exploration Co. Ltd. did a small diamond-drill program on their claims in Stull Lake.

Several OPAP funded prospectors explored the North Spirit Lake greenstone belt.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

The Resident Geologist's office was staffed by B. Atkinson, Resident Geologist, J. Parker, Staff Geologist and L. Kosloski, Secretary. During the year L. Kosloski was seconded as a Data Folio Geologist and the Secretarial Position was contracted to C. Sundstrom. Other contract staff employed through the year were C. Godby, Office Assistant, C. Szafilk, Field Assistant, J. Richthammer, Historical Researcher, M. Reid, Computer

Figure 3.2
Red Lake Resident Geologist's District
Property Examinations


EXPLANATION
◆ Property Examinations, 1991
① OGS Field Party Locations, 1991 (keyed to text)
● Drill Core Locations
— Recently Released Maps, area of coverage
-·- Geological Data Inventory Folios in preparation, area of coverage
District Boundary
95°
94°
93°
92°
53°
52°
51°
Scale
0
25 mi.
0
20
40 Km
Favourable Lake
Deer Lake
North Spirit Lake
Sandy Lake
Finger Lake
McInnes Lake
MacDowell Lake
Stout Lake
Berens River
Bloodvein
River
Trout Lake
Birch Lake
Confederation Lake
Pakwash Lake
Cat Lake
3107
81 595-
81 669
①
②
③

Assistant, and H. Brown, Geological Assistant. L. Kowalchuk was employed under a Section 25 work program.

In December, 1991, J. Parker was seconded to develop a provincial prospecting manual. The Staff Geologist position was contracted to H. Brown.

I. Torok and G. Laws of Double Rainbow Exploration Services Inc. completed data input for the Mineral Deposit Inventory part of the Geoscience Exploration Database.

Office staff guided 11 field trips, 25 property visits to area geology and presented 3 information sessions to exploration personnel and to the Red Lake branch of the Canadian Institute of Mines, Metallurgy and Petroleum and the Red Lake Chamber of Commerce. J. Parker presented an Advanced Geophysics Prospecting Course to local prospectors.

An Open File Report consisting of property descriptions of all known gold deposits in the Birch–Confederation lakes area was completed (Parker and Atkinson, in press).

B. Atkinson completed quarter-mile mapping and marginal notes for Baird Township (Wallace and Atkinson, in press) and contributed to the Critchell Lake, Red Lake and Pipestone Bay 1:50000 scale preliminary geological maps.

J. Parker continued an inventory of base metal occurrences in the western Uchi Subprovince.

L. Kosloski completed Geoscience Data Inventory Folios for Brownstone, Keigat, Little Shabumeni, Satterly, Seagrave and Shabumeni lakes.

B. Atkinson presented a talk entitled "Lead Isotope Investigations Bearing on the Source of Gold and Other Mineralization in the Red Lake Area", co-authored by B. Gulson, at the Thunder Bay, Ontario Mines and Minerals Symposium in April, 1991. A second talk entitled "Geology of the Hornby Lake Greenstone Belt: Where Did the Red Lake Komatiites Go?" was presented at the Toronto, Ontario Mines and Minerals Symposium in December, 1991. J. Parker presented a talk entitled "Mining and Exploration Activity in the Red Lake District—1990" at the Thunder Bay Mines and Minerals Symposium.

B. Atkinson and C. Szaflik spent one week at Findlay Lake doing reconnaissance mapping and examining mineral occurrences. Results of that work are summarized below.

The Red Lake office handled 1500 client consultations through the year.

ACKNOWLEDGMENTS

C. Sundstrom typed the manuscript and compiled information for several of the map figures. H. Brown drafted several figures that accompany the report. K.G. Fenwick, Manager, Mineral Resources edited the text.

Information on past work included in this report is taken from assessment files of the Resident Geologist's office, Red Lake District, Red Lake, unless otherwise indicated.

RECONNAISSANCE OF THE HORNBY LAKE GREENSTONE BELT

Introduction

As part of ongoing investigations of northern greenstone belts in the Red Lake Resident Geologist's District, the Findlay Lake part of the Hornby Lake greenstone belt was examined during the 1991 field season. This work completes examination of the Hornby Lake greenstone belt; the west side has been previously described (*see* Atkinson and Storey 1988).

Findlay Lake is located 155 km north of Red Lake and is accessed by float equipped aircraft, as no roads enter the immediate area.

The natural drainage of the area exploits major joint systems and lineaments in granitoid rocks enclosing the greenstone belt, links between lakes are closely channelled waterways with few short rapids. Boat access is unimpeded between Findlay and Russell lakes. The 3 short rapids between Russell and Cornelius lakes are easily crossed.

A good campsite is located on the east side of the large island in the northwest arm of Findlay Lake.

Glacial striae indicate ice movement in the area was from the east-northeast. Overburden is generally a thin cover of sandy glacial tills and accumulations of humus muck underlying swampy areas. Much bedrock is exposed and the lakeshores are either outcrop or boulder armoured. Sand beaches are rare on Findlay Lake but several occur on Russell Lake, usually on north shorelines of the lake. Extensive glacially polished and rounded outcrops are common around the lakes in the area. Recent forest fires have enhanced outcrop exposures. The land shows moderate topographic relief. A series of east-trending valleys and ridges north of Findlay Lake make traversing against the grain of the country difficult.

Previous Work

Geological mapping of the Hornby Lake greenstone belt includes 1 inch to 2 mile scale mapping by Ayres et al. (1972) and 1:50 000 scale mapping by Stone et al. (in press). Cortis et al. (1988) did a geological reconnaissance of the Findlay Lake area.

General Geology

The geology of the Hornby Lake greenstone belt is divisible into 2 natural lithostratigraphic subdivisions referred to as the

Table 3.2. Exploration activity during the year.

Number on Figure	Individual or Company	Activity
1	Asarco Exploration Co. of Canada Ltd.	Line cutting and ground geophysical surveys on 17 claim groups (110 claims), Goodall and Skinner townships and on Karas Lake, Slate Lake, Avis Lake, Hailstone Lake, Jubilee Lake, Little Shabumeni Lake, and Uchi Lake and Earngey Township map sheets
2	Aur Resources Inc.	Line cutting, ground magnetic and electromagnetic surveys, diamond drilling (3) 678 m. Fairlie, Baird, Heyson and Dome townships
3	BHP-Utah Mines Ltd.	Geological mapping, prospecting, lithogeochemical sampling on Fly Lake property, Mitchell and Bowerman townships
4	English P./Desmeules, M.	Prospecting, Deedee Lake map sheet, power stripping, Baird Township
5	Gold Fields Canadian Mining Ltd.	Airborne geophysical survey, Casummit Lake map sheet
6	Hawke, D./Campbell, G.	Geophysical surveys, Gerry Lake map sheet
7	Herbert, L.	Diamond drilling (4) 1006 m, East Bay property, Bateman Township
8	Hermiston, W.	Prospecting, Deedee Lake map sheet
9	Hodgson, R.	Prospecting, Swain Lake area, Shabumeni Lake map sheet, prospecting Hewitt Lake map sheet
10	Intelisano, J.	Powerstripping, sampling, Bateman Township
11	Joutel Resources Ltd.	Airborne geophysical survey, Satterly Lake map sheet
12	Maciejewski, A./Bobinski, M.	Power stripping, sampling and prospecting, Baird Township
13	McNerney, Wm.	Diamond drilling (2) 98 m Headway property, Dome and Balmer townships
14	Minnova Inc.	228 km line cutting, 100 km geophysical surveys, 2000 lithogeochemical sample analyses, diamond drilling (6) 2700 m on Confederation Lake property, Mitchell, Bowerman, Earngey and Belanger townships
15	Noranda Exploration Company Ltd.	Lithogeochemical sampling, geophysical surveys, diamond drilling (4) 1200 m, South of Otter Lake map sheet, Karas Lake map sheet
		Prospecting, trenching, induced polarization and magnetic surveys, Satterly Lake and Casummit Lake map sheets
		Diamond drilling (3) 75 m, Stull Lake map sheet
16	Peterson, C.	Diamond drilling, Skookum Bay, Dome Township
17	Placer Dome Inc.	30 km line cutting, geological mapping, lithogeochemcial sampling, 20 km induced polarization surveys and diamond drilling (12) 2275 m on East Bay property, Bateman Township
		53 km line cutting, magnetic and electromagnetic surveys on Gullrock Lake property, Willans Township
		122 km line cutting, geological mapping, lithogeochemical sampling, magnetic and electro magnetic surveys on 105 claims, Martin Bay property, Baird, Fairlie and Todd townships
		66.4 km line cutting, 187 km magnetic and electromagnetic surveys, geological mapping and diamond drilling (13) 2177 m, on Sobel Lake property, Otter Lake and South of Otter Lake map sheets
		20 km induced polarization surveys, McInnes Lake
18	Rio Algom Exploration Inc.	42 km line cutting, geological mapping, lithogeochemical sampling on Fly Lake property, Bowerman and Mitchell townships
19	Rivard, O.	Prospecting, diamond drilling, Heath property, Todd Township, diamond drilling (1) 180 m East Bay, Bateman Township
20	Starmin Mining Inc.	Geological mapping, sampling, Patricia Dent property, Dent Township
21	Teck Corporation	20 km induced polarization surveys, geological mapping, diamond drilling (11) 2000 m, Dixie Lake map sheet
22	Williamson, J.	Power stripping, prospecting, Belanger Township, and Avis Lake map sheet

Western Hornby Assemblage and the Findlay Assemblage (Thurston, Osmani and Stone 1991). The Western Hornby Assemblage underlies Hornby Lake and the west side of the greenstone belt, the Findlay Assemblage underlies the east side of the belt including Findlay and Cornelius lakes. The geology of the Hornby Lake greenstone belt is shown in Figure 3.3.

FINDLAY ASSEMBLAGE

The Findlay Lake assemblage includes a 400 m wide felsic to intermediate unit of pyroclastic rocks and both chemical and clastic metasedimentary rocks. Metavolcanic rocks of the Findlay Assemblage include tuffs and pyroclastic breccias that outcrop on the west side of Findlay Lake. Eastward, the metavolcanic rocks give way to metasedimentary rocks including thinly bedded wacke, iron formation, chert, mudstone, lithic wacke and quartz arenite. The metasediments are variably affected by metamorphism. Garnet porphyroblasts are common to all lithologies while sillimanite is noted in metamorphosed mudstones and wackes. The metasediments are transformed to grey gneiss adjacent to the enclosing batholithic contact along the west shore of Cornelius Lake.

A thin horizon of chert and magnetite outcrops on the south shore of Findlay Lake. In places it is entirely altered to recrystallized beds of quartz and garnetite.

An island in Cornelius Lake is underlain by biotitized wacke metasediments. A garnet-bearing, two-mica granite intrudes the metasediments.

WESTERN HORNBY ASSEMBLAGE

The Western Hornby Assemblage is largely composed of mafic metavolcanic flows, these include pillowed to massive units and lessor amounts of komatiitic flows and related peridotitic intrusions. A thin unit of mafic heterolithic conglomerate with elongate clasts up to cobble size caps the east-facing Western Hornby Assemblage where it contacts the Findlay Assemblage.

Structure

Limited structural evidence from pillow-facing directions indicate the Western Hornby Assemblage is east facing, in contrast to west-facing graded beds of felsic tuff of the Findlay Assemblage. The occurrence of parallel bodies of ultramafic rocks in the 2 northeast-trending arms of Hornby Lake may be the result of fold repetition of lithologies.

Metasediments underlying Findlay Lake are affected by broad open folds that generally have moderate southeast plunges. Both fold intensity and fold closures increase towards the margins of the belt.

Lithologies at the contact between the Western Hornby Assemblage and the Findlay Assemblage are strained, the opposite facing directions recorded across the contact imply a structural discontinuity. Structural trends of foliation describe arcuate trajectories around Findlay Lake, conformable to the shape of the lake. In the west part of the lake, foliations are generally north trending but swing westerly in the central lake area and northeasterly in the east lake area.

MINERAL OCCURRENCES

ASBESTOS CORP. LTD.'S NO. 3 DISCOVERY

A series of north-trending pits and trenches have been excavated on a sulphide bearing horizon located 400 m west of Findlay Lake by Asbestos Corp. Ltd. in 1968 (*see* Figure 3.3). Host rocks consist of intermediate metavolcanic schists trending 145°/80°E. Mineral lineations on the schist planes plunge 058°S. Thin section analysis indicates the schist is composed of 30% biotite, 25% fine-grained feldspar and quartz, 15% muscovite, 15% altered material and accessory garnet, sillimanite, graphite and pyrrhotite.

Trenches occur in 3 clusters over a strike length of 720 m. The northernmost group of trenches generally has a higher sulphide content of pyrrhotite and minor chalcopyrite. A small amount of white crystalline marble was noted in one of these trenches. The northern trenches were found 20 m north-northwest of claim post No. 1 for claim 60411. The 3 trenches in the north group were all less than 5 m long by 1 m deep.

The central group of trenches are located 240 m south of the north group. The main central trench is 25 m long by 2 m wide by 1 to 2 m deep. Mineralization occurs as disseminations of pyrrhotite in graphite-bearing schists that trend 156°/79°E. Several other nearby trenches are heavily rust-stained and pyrrhotite-bearing. A diamond drill hole collar trending 220°/45°SW is located at the west side of the central trench.

The southernmost trenches are located 480 m south of the central trenches, and are heavily mineralized with pyrrhotite.

A dozen samples were collected from the 3 groups of trenches for analysis. The results (Geoscience Laboratories, Ontario Geological Survey, Toronto) are as follows:

South Showing:

Sample No.	Au (ppb)	Ag (ppm)	Cu (ppm)	Zn (ppm)
91-BTA-36	<2	<2	9	16
-37	<2	<2	10	27
-38	<2	<2	34	33
-39	<2	<2	11	34
-40	<2	<2	10	136
-49	3	<2	75	115

Central Showing:

Sample No.	Au (ppb)	Ag (ppm)	Cu (ppm)	Zn (ppm)
91-BTA-41	<2	<2	203	173
-42	<2	<2	89	175

North Showing:

Sample No.	Au (ppb)	Ag (ppm)	Cu (ppm)	Zn (ppm)
91-BTA-41	<2	<2	203	173
91-BTA-44	<2	<2	32	117
-45	<2	<2	101	102
-46	<2	2	6	<10
-47	3	<2	52	68

A number of rust-stained outcrops were examined around Findlay and Cornelius lakes. These outcrops of metasedimentary rocks are composed largely of quartz, biotite and plagioclase schists and carry very little sulphide. Grab samples from a number of such rusty outcrops consistently analyzed less than 10 ppb Au. A sample from a rusty zone on the south side of the river between Findlay and Russell lakes analyzed 17 ppb Au (Geoscience Laboratories, Ontario Geological Survey, Toronto).

GOLD POTENTIAL IN THE BIRCH–CONFEDERATION–UCHI LAKES GREENSTONE BELT

Introduction

Intensive gold exploration began in the Birch–Confederation–Uchi lakes greenstone belt in 1926, shortly after the discovery of gold at Red Lake. Exploration resulted in the discovery and development of 9 gold mines which produced 247 421.84 ounces of gold between 1928 and 1966 (Parker and Atkinson, in press). Gold exploration reached peak levels during the 1980s. As a result, new gold discoveries were made and abundant new information was generated on the older gold properties. This information has recently been compiled into an Open File Report (Parker and Atkinson, in press) which is a result of a project initiated by the Resident Geologist's office, Red Lake. The main body of the Open File Report is comprised of over 100 property descriptions of gold deposits in the belt.

This report summarizes observations made during the preparation of the Open File Report and is a description of the regional distribution of gold mineralization in the Birch–Confederation–Uchi lakes greenstone belt, with emphasis on specific areas with good potential for new gold discoveries.

Regional Geological Setting

The Birch–Confederation–Uchi lakes greenstone belt is composed of mafic, intermediate and felsic, metavolcanic flows and pyroclastic rocks with subordinate metasedimentary rocks. The south and southwestern margin of the belt consists of linear units of metavolcanic rocks alternating with thick sequences of clastic metasedimentary rocks (Figure 3.4).

An alkalic metavolcanic complex with an associated carbonatite intrusion situated at Springpole Lake, in the northern eastern part of the greenstone belt, is interpreted to be part of a discrete allochthonous assemblage of rocks which are distinct from the rest of the greenstone belt (*see* Figure 3.4; Barron et al. 1989; Thurston 1986).

The metavolcanic-metasedimentary assemblage has been intruded by large, composite, granitoid complexes and by smaller, late, mafic to felsic stocks, plugs, dikes and sills. Supracrustal rocks are commonly metamorphosed to greenschist-grade assemblages over wide areas while amphibolite-grade rocks are more locally concentrated within the contact aureoles of the large granitic batholiths and smaller intrusions.

Three metavolcanic-metasedimentary cycles have been recognized and described in the Confederation Lake area (Figure 3.5; Goodwin 1967; Pryslak 1971a, 1971b; Thurston 1985). Each cycle begins with tholeiitic, pillowed, mafic to intermediate flows overlain by calc-alkalic, intermediate to felsic pyroclastic rocks and minor flows capped by thin units of iron formation and marble. Cycle I is a platform sequence upon which Cycle II was deposited during early caldera development. Cycle III was produced by resurgent volcanism and contains high level, porphyritic, felsic intrusions and the South Bay copper-zinc-silver massive sulphide deposit (Thurston 1985). The 3 cycles have been correlated with metavolcanic sequences at Birch and Casummit lakes, Slate Lake and Red Lake (Wallace et al. 1986; Thurston 1986).

Large-scale folding is common throughout the belt (Figure 3.6). A north-trending syncline is situated at Confederation Lake and tight, north-trending folds have been documented between Confederation and Uchi lakes (Thurston 1985). Northwest-trending anticlinal and synclinal fold axes occur southeast of Uchi Lake (Thurston and Bartlett 1981) and an east-trending synclinal fold axis extends east of Slate Lake (Bowen 1989b). Northwest- and north-trending synclinal folds are centered on Shabu Lake and may be part of a single, complex or refolded fold (Fyon and O'Donnell 1986). A series of northwest-trending, overturned folds occur in the eastern part of Birch Lake (Good 1988). Major, northeast- and east-trending folds are situated at Shabumeni Lake and in the west part of Birch Lake (*see* Figure 3.6; Beakhouse 1989).

The belt has been affected by at least 3 periods of deformation related to compressional forces resulting from the diapiric emplacement of adjacent granitoid complexes (Fyon and Lane 1985, 1986; Fyon and O'Donnell 1986; Good 1988; Beakhouse 1989, 1990). The style and intensity of deformation is variable and commonly characterized by linear zones of high strain separated by areas of less deformed or strained rocks. Zones of high strain also occur within the contact aureoles of granitic batholiths and stocks. North- and northeast-trending deformation zones and faults dominate at Confederation, Woman and Uchi lakes (*see* Figure 3.6; Fyon and Lane 1986). Northwest- and west-northwest-trending deformation zones occur in the east part of Birch Lake and at Casummit Lake (*see* Figure 3.6; Good 1988; Beakhouse 1990). Northeast-trending deformation zones dominate at

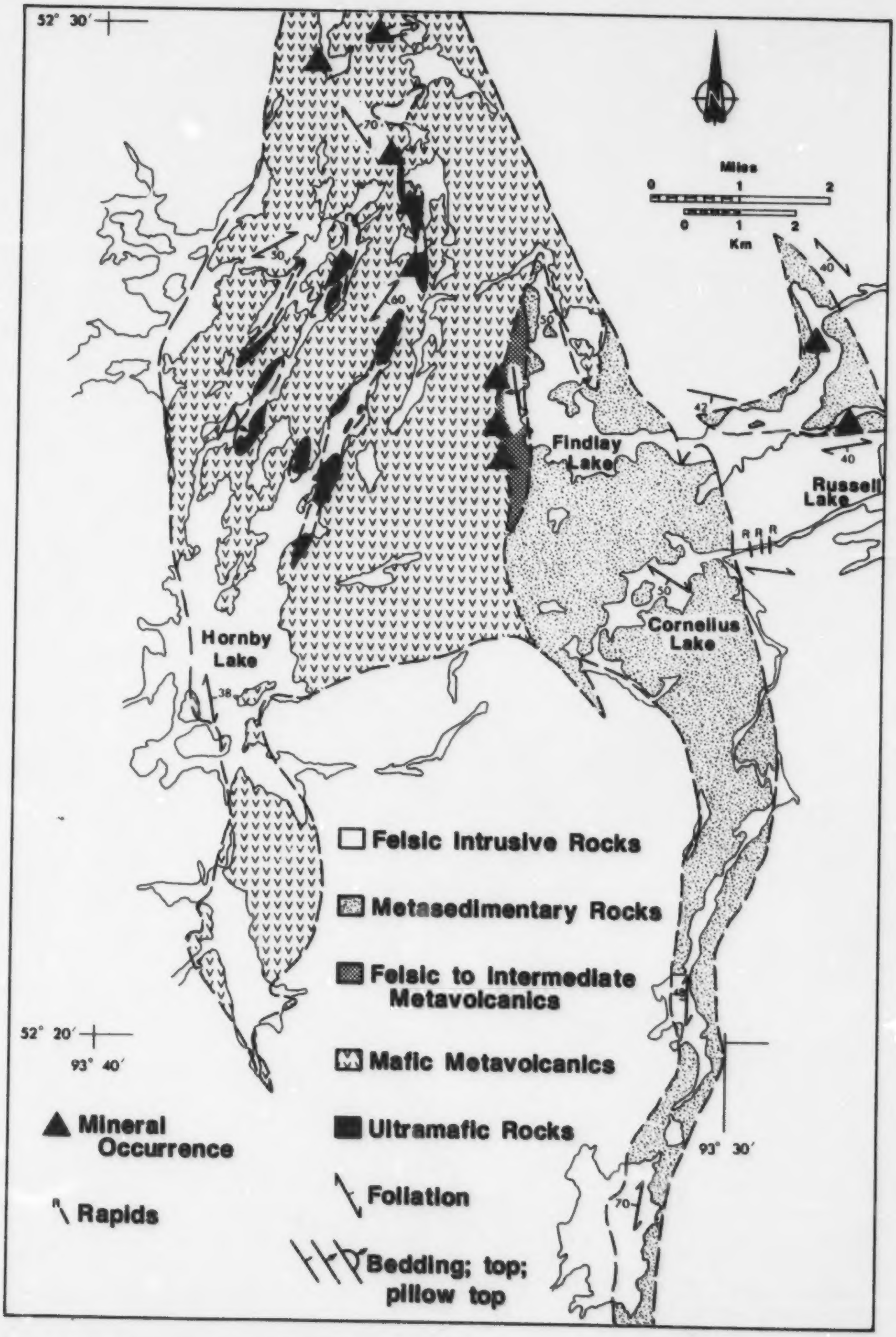

52° 30′
Miles
0
1
2
0
1
2
Km
70
50
60
50
40
42
40
Findlay Lake
Russell Lake
R R R
50
Cornelius Lake
Hornby Lake
38
Felsic Intrusive Rocks
Metasedimentary Rocks
Felsic to Intermediate Metavolcanics
Mafic Metavolcanics
Ultramafic Rocks
Foliation
Bedding; top; pillow top
Mineral Occurrence
Rapids
52° 20′
93° 40′
48
93° 30′
70

Figure 3.3 Geology of the Hornby Lake Greenstone Belt.

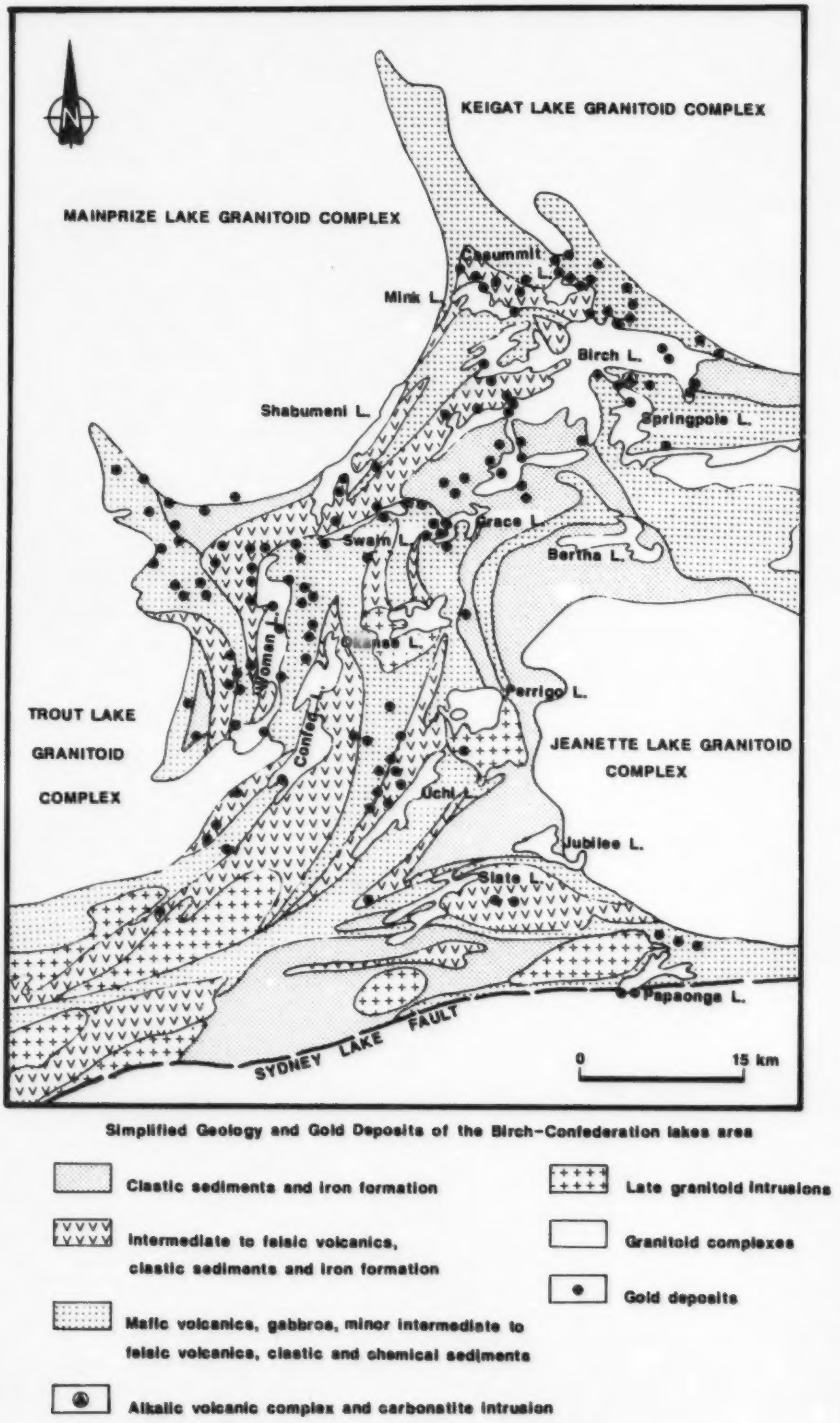
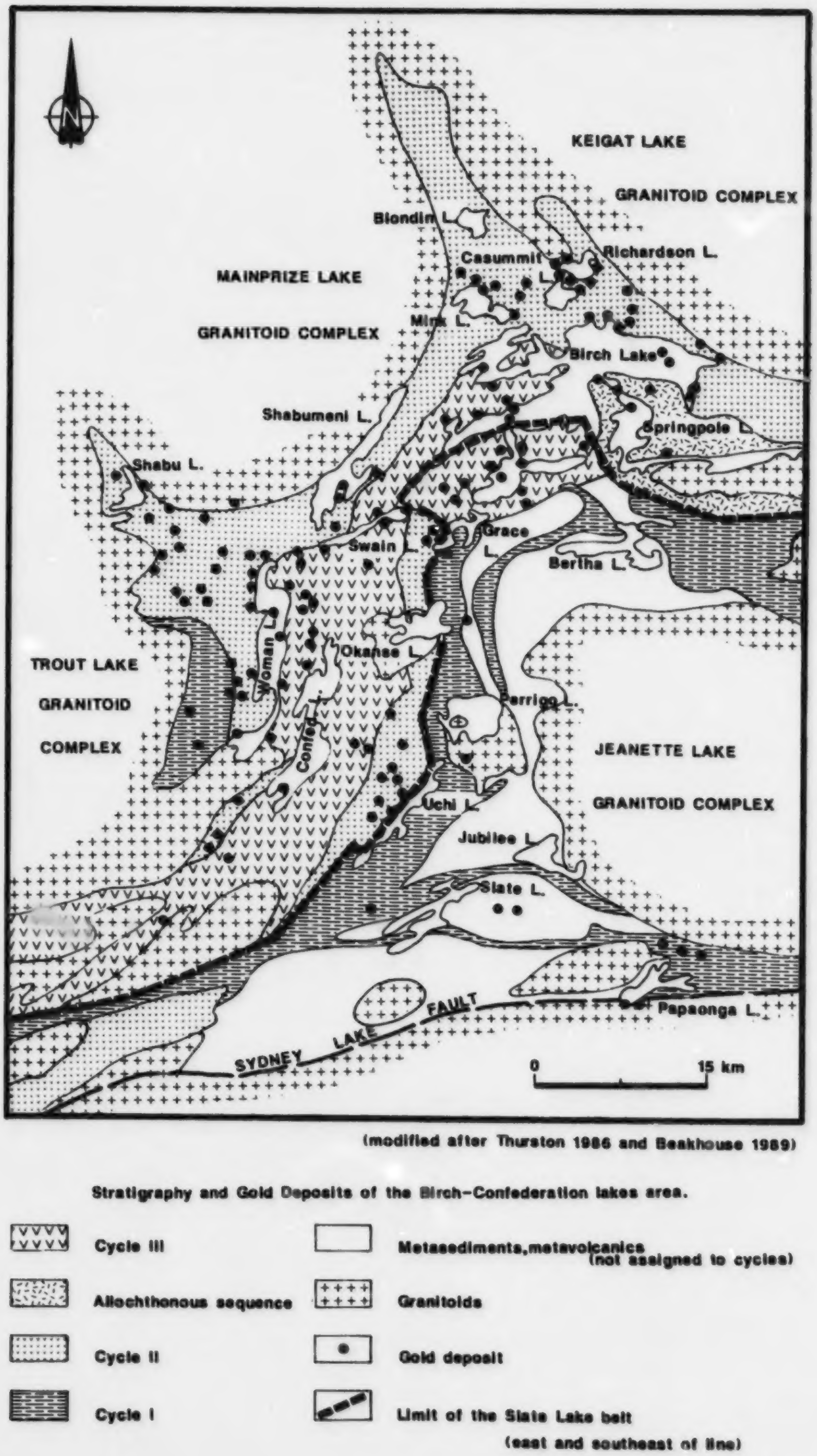

N
KEIGAT LAKE GRANITOID COMPLEX
MAINPRIZE LAKE GRANITOID COMPLEX
Casummit L.
Mink L.
Birch L.
Springpole L.
Shabumeni L.
Grace L.
Swain L.
Bertha L.
Woman L.
Okanse L.
Confed. L.
Perrigo L.
TROUT LAKE GRANITOID COMPLEX
JEANETTE LAKE GRANITOID COMPLEX
Uchi L.
Jubilee L.
Slate L.
Papaonga L.
SYDNEY LAKE FAULT
0
15 km
Simplified Geology and Gold Deposits of the Birch–Confederation lakes area
Clastic sediments and iron formation
Intermediate to felsic volcanics, clastic sediments and iron formation
Mafic volcanics, gabbros, minor intermediate to felsic volcanics, clastic and chemical sediments
Alkalic volcanic complex and carbonatite intrusion
Late granitoid intrusions
Granitoid complexes
Gold deposits

Figure 3.4 Simplified Geology and Gold Deposits of the Birch–Confederation lakes area.


N
KEIGAT LAKE
GRANITOID COMPLEX
Blondin L.
Casummit L.
Richardson L.
MAINPRIZE LAKE
GRANITOID COMPLEX
Mink L.
Birch Lake
Shabumeni L.
Springpole L.
Shabu L.
Swain L.
Grace L.
Bertha L.
Woman L.
Okanse L.
TROUT LAKE
GRANITOID
COMPLEX
Confed. L.
Perrigo L.
JEANETTE LAKE
GRANITOID COMPLEX
Uchi L.
Jubilee L.
Slate L.
Papaonga L.
SYDNEY LAKE FAULT
0
15 km
Cycle III
Metasediments, metavolcanics (not assigned to cycles)
Allochthonous sequence
Granitoids
Cycle II
Gold deposit
Cycle I
Limit of the Slate Lake belt (east and southeast of line)

(modified after Thurston 1986 and Beakhouse 1989)

Stratigraphy and Gold Deposits of the Birch–Confederation lakes area.

Figure 3.5 Stratigraphy and Gold Deposits of the Birch–Confederation lakes area.

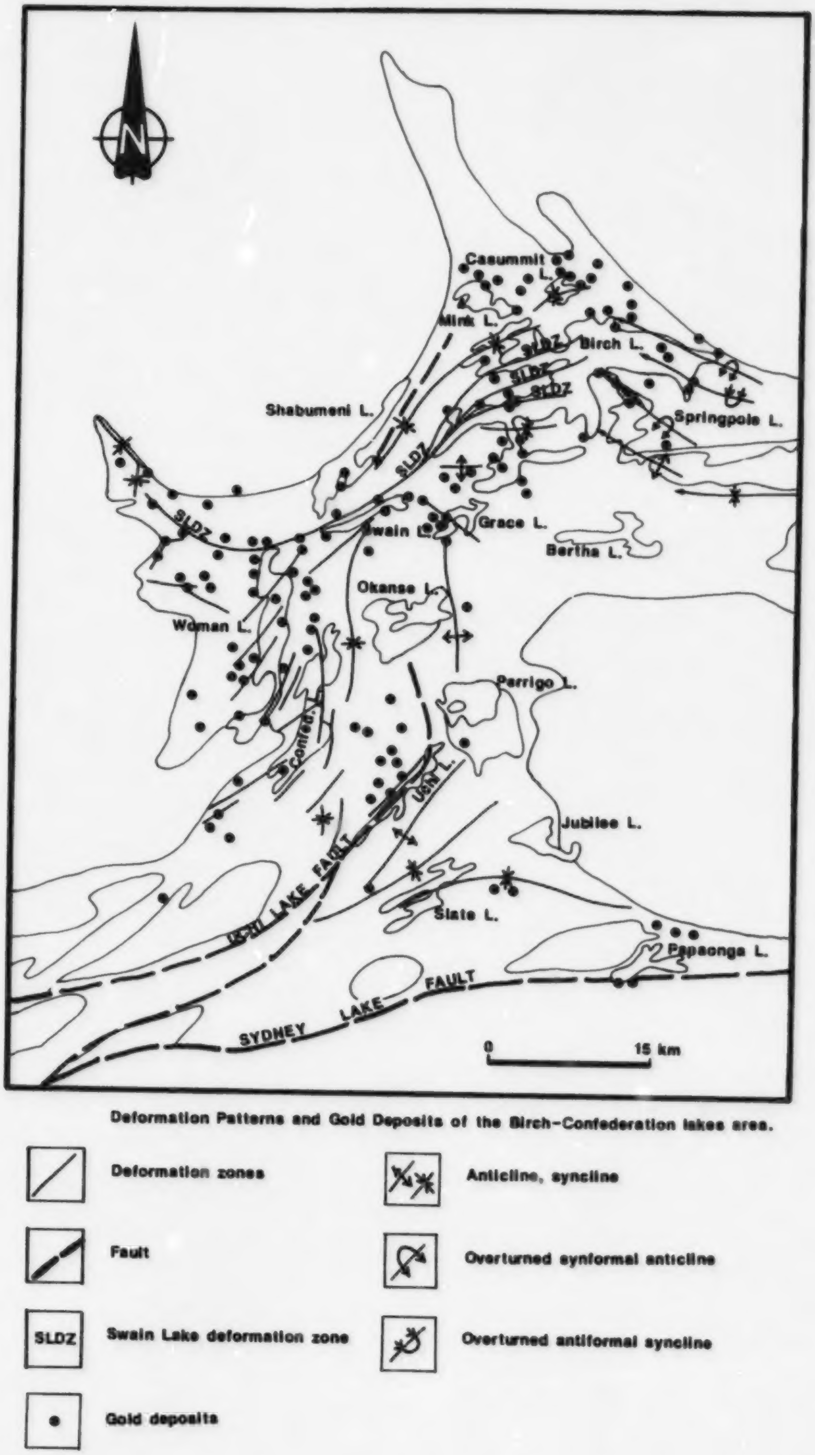

N
Casummit L.
Mink L.
SLDZ
Birch L.
SLDZ
SLDZ
Springpole L.
Shabumeni L.
SLDZ
SLDZ
Swain L.
Grace L.
Bertha L.
Okanse L.
Woman L.
Perrigo L.
Confed.
Uchi L.
Jubilee L.
UCHI LAKE FAULT
Slate L.
Papaonga L.
FAULT
SYDNEY LAKE
0
15 km
Deformation Patterns and Gold Deposits of the Birch–Confederation lakes area.
Deformation zones
Anticline, syncline
Fault
Overturned synformal anticline
SLDZ
Swain Lake deformation zone
Overturned antiformal syncline
Gold deposits

Figure 3.6 Deformation Patterns and Gold Deposits of the Birch–Confederation lakes area.

Shabumeni and Swain lakes and in the west part of Birch Lake (Beakhouse 1989). The east-northeast-trending Swain Lake deformation zone extends across the greenstone belt from Shabu and Leonard lakes in the west (Pryslak 1973, 1974) to Swain Lake and the western Birch Lake area (*see* Figure 3.6; Beakhouse 1989).

Regional Distribution of Gold Mineralization

There are 110 known gold deposits in the Birch–Confederation–Uchi lakes greenstone belt, the majority of which consist of structurally controlled, gold-bearing quartz veins hosted by shear zones and/or fracture zones concentrated in areas of greenschist-grade metamorphism. Several gold properties at Birch and Springpole lakes, such as the Horseshoe Island prospect, Springpole Lake prospect and Wagner-Melanson prospect, consist of broad, intensely altered deformation zones containing widespread disseminated sulphides and gold.

Gold-bearing quartz vein systems are associated with deformation zones trending north and northeast at Confederation, Woman and Uchi lakes, east-northeast at Swain and Shabumeni lakes and in the west part of Birch Lake and northwest- to west-northwest at Casummit Lake and in the east part of Birch Lake (*see* Figure 3.6; Fyon and Lane 1986; Good 1988; Beakhouse 1989, 1990). Gold mineralization commonly occurs along the Swain Lake deformation zone (*see* Figure 3.6) at Leonard, Car, Woman, Swain and Birch lakes. The Swain Lake deformation zone trends northwest at Leonard Lake and changes orientation to northeast at Swain, Woman and Birch lakes. The majority of the mineralized deformation zones are related to a second and possibly third deformational phase that affected the greenstone belt (Fyon and O'Donnell 1986; Good 1988; Beakhouse 1990).

Stratigraphy has influenced the localization of gold mineralization by providing lithological contrasts that created zones susceptible to alteration and deformation. Examples of this are at Uchi Lake where gold deposits are situated at contacts between mafic and felsic rock types and in the west part of Birch Lake where gold is associated with competent granodioritic stocks and plugs which intrude less competent metasediments.

There is also a strong correlation between gold deposits and the 3 metavolcanic-metasedimentary cycles in the belt. Approximately 53% of all gold deposits in the Birch–Confederation–Uchi lakes belt are situated within the Cycle II sequence, 31% occur in Cycle III, 7% occur in Cycle I and 9% in granitoid rocks and the allochthonous metavolcanic-metasedimentary assemblage at Springpole Lake (*see* Figure 3.5). About 88% of all gold produced from the belt was extracted from mines situated within the Cycle II sequence, 12% of gold production came from mines in Cycle III.

Gold deposits are most commonly hosted by mafic metavolcanic rocks followed by felsic metavolcanic rocks, clastic and chemical metasediments and felsic to mafic intrusive rocks. Few gold occurrences are located at the margins of the surrounding granitoid complexes and only 3 occurrences are hosted by granitoid rocks.

Gold Potential

Several areas within the Birch–Confederation–Uchi lakes greenstone belt have good gold potential where prospecting may result in new gold discoveries. Several of these areas are described below.

LEONARD LAKE

Leonard Lake is a long, northwest-trending lake situated near the north boundary of Skinner Township and 2 km southeast of Shabu Lake, near the northwest margin of the Birch–Confederation–Uchi lakes belt. Four separate gold occurrences are situated north, southwest, east and west of Leonard Lake and are indicated on Preliminary Map P.973 (Pryslak 1974). All of the occurrences were open for staking at the time of writing.

The Leonard Lake area is underlain by east-trending, intermediate to mafic metavolcanic rocks intercalated with fine-grained clastic metasediments of the Cycle II metavolcanic sequence (Thurston 1986). The metavolcanic and metasedimentary rocks are intruded by gabbro sills and granitoid rocks of the Mainprize Lake granitoid complex. The northwest-trending Swain Lake deformation zone or fault extends from Swain Lake through the southeastern end of Leonard Lake (Pryslak 1972b, 1974). The deformation zone extends along the contact between metasediments, situated northeast of Leonard Lake, and metavolcanic rocks southwest of the lake.

The gold occurrences situated north and west of Leonard Lake are hosted by granodioritic rocks at the contacts between granodiorite and metasediments or mafic metavolcanic rocks. An occurrence east of Leonard Lake is hosted by fine-grained, clastic metasediments near a small gabbro intrusion. Numerous trenches have been sunk on quartz veins on the southwest shore of Leonard Lake. The quartz veins are hosted by chlorite-sericite schist and extend along the Swain Lake fault or deformation zone (Pryslak 1974; Fyon and Lane 1986) which is known to host gold mineralization elsewhere along its strike length.

A gold occurrence situated 500 m southwest of Leonard Lake has been previously documented by Bruce (1929). Three east-trending, quartz veins are hosted by 4 foot wide shear zones in coarse-grained gabbro. The quartz veins are reported to contain gold mineralization associated with massive arsenopyrite in "considerable quantities" (Bruce 1929). Pryslak (1974) also reported arsenopyrite at the gold occurrence west of Leonard Lake. Pryslak (1974) has indicated the presence of gold at several of the occurrences but no specific gold values have been reported.

Leonard Narrow Lake Gold Mines Ltd. conducted the most significant exploration work at Leonard Lake in 1927 (Bruce 1929). Several companies have conducted airborne geophysical surveys over the area but no significant work has been reported at the occurrences.

Widespread gold mineralization associated with arsenopyrite occurs in several geological settings at Leonard Lake where very little gold exploration has been conducted. The presence of the Swain Lake deformation zone at Leonard Lake enhances the gold potential of the area. Fyon and O'Donnell (1986) recognized a potential gold-bearing zone at Shabu Lake, 2 km northwest of Leonard Lake. The zone is 3 km long and extends along the northwestern arm of Shabu Lake. The zone consists of an intensely sericitized and iron carbonatized quartz-feldspar porphyry unit that hosts up to 5% disseminated pyrite (Fyon and O'Donnell 1986).

WOMAN–WASHAGOMIS LAKES

Woman and Washagomis lakes are situated in Goodall Township in the central part of the Birch–Confederation–Uchi lakes greenstone belt. The area is underlain by north-trending, mafic and intermediate, massive, amygdaloidal, pillowed and spherulitic flows, intercalated with intermediate to felsic pyroclastic rocks of the Cycle III metavolcanic sequence (Pryslak 1972a; Thurston 1985). The metavolcanic rocks are intruded by gabbroic and dioritic sills and dikes.

The east-northeast-trending Swain Lake deformation zone extends through most of the area and is strongly developed in the northern parts of Woman and Washagomis lakes (Fyon and Lane 1986; Fyon and O'Donnell 1986). Gold mineralization is commonly hosted by quartz-carbonate veins in northeast- and east-northeast-trending shear zones accompanied by intense iron carbonatization, sericitization, chloritization and silicification. Widespread iron carbonate alteration occurs throughout the northern part of the Woman Lake area. Iron carbonate veins and breccia zones are common in the intermediate to felsic pyroclastic rocks west and northwest of Woman Lake (Fyon and O'Donnell 1986).

Noramco Explorations Inc. and Western Pacific Energy Corporation conducted intensive gold exploration at Woman and Washagomis lakes between 1987 and 1988. The companies discovered numerous new gold showings and outlined extensive areas of widespread anomalous gold mineralization. Many of the occurrences consist of east-northeast-trending quartz vein systems in intensely altered shear zones. Gold is commonly associated with a variety of sulphides including pyrite, arsenopyrite, chalcopyrite, galena, sphalerite and pyrrhotite.

Anomalous gold values ranging between 114 and 5111 ppb Au were obtained by Noramco Explorations Inc. along the northwest portion of the lakeshore of Woman Lake. The gold is associated with strong iron carbonate alteration and arsenopyrite mineralization in sheared intermediate and felsic pyroclastic rocks. At the extreme north end of Woman Lake gold values ranging between 38 and 899 ppb Au were obtained from several sulphide occurrences which are indicated on Preliminary Map P.763 (Pryslak 1972a). Some of these occurrences were open for staking at the time of writing. Noramco also discovered gold mineralization at Mousseau and Mosier lakes situated due west of Woman Lake in Skinner Township.

Western Pacific Energy Corporation discovered widespread gold mineralization in the vicinity of Washagomis Lake. A gold value of 1365 ppb Au was obtained from intensely silicified rocks hosting 20% pyrite within the Swain Lake deformation zone, west-northwest of Washagomis Lake. Other gold values ranging between 840 and 3607 ppb Au were obtained from quartz veins and shear zones east and north of Washagomis Lake. Fyon and O'Donnell (1986) observed quartz-iron carbonate veins up to 0.5 m wide and 50 m long on the north shore of the lake. Quartz veins and sericitized wall rocks, adjacent to the carbonate veins, host disseminated pyrite and arsenopyrite (Fyon and O'Donnell 1986).

Numerous gold values ranging between 132 and 877 ppb Au were reported by Western Pacific Energy Corporation from samples from the shores of Waque Bay (local name) on Woman Lake. Waque Bay is a small northeast-trending bay located northeast of Picard Island. Gold mineralization is hosted by sheared and carbonatized mafic metavolcanic and metasedimentary rocks hosting between 2% and 30% disseminated pyrite.

The widespread iron carbonate alteration, gold and arsenopyrite mineralization and strong, northeast-trending structures at Woman and Washagomis lakes make the area a good gold exploration target. Many of the gold discoveries made by Noramco and Western Pacific Energy have never been followed up and several of them were open for staking at the time of writing.

BOBARRIS LAKE

Bobarris Lake is a narrow, west-northwest-trending lake located about 1 km due west of Swain Lake. The lake is indicated on Preliminary Map P.3118 (Beakhouse et al. 1989). Intermediate pyroclastic rocks intercalated with mafic metavolcanic flows occur southwest of Bobarris Lake. Metasediments consisting of polymictic conglomerate and arenite occur northeast of the lake (Beakhouse et al. 1989). The metavolcanic and metasedimentary rocks are part of the Cycle III metavolcanic sequence (Thurston 1986).

A northwest-trending fault, enveloped by an area of high strain, extends along the southwest shore of Bobarris Lake at the contact between the metavolcanic and metasedimentary rocks (Beakhouse et al. 1989). The fault extends southeast through Grace Lake (Fyon and O'Donnell 1986) and terminates in the vicinity of Wilkins Lake in the northwest corner of McNaughton Township (Johns and Falls 1976). The fault has been traced for an approximate strike length of 8.8 km. Fyon and O'Donnell (1986) determined that the fault has a dextral, horizontal component, and a northeast-side-up, vertical, component.

Intensely altered, strongly foliated rocks occur along the length of the fault at Bobarris Lake. Alteration consists of sericite, tourmaline and disseminated iron carbonate and pyrite (Beakhouse et al. 1989; Beakhouse 1989). Fyon and O'Donnell (1986) recognized chloritization, sericitization and disseminated pyrite within the fault zone at Grace Lake.

A grab sample taken by Explorco Properties Inc. from an outcrop within the fault zone, at the extreme northwest end of Bobarris Lake, analyzed 1500 ppb Au. This occurrence is about 800 m due east of the Guest gold-copper prospect at Swain Lake. Gold is also associated with the fault at Grace Lake where R. Hodgson obtained a gold value of 755 ppb Au from an old test pit within the fault zone. The Sol D'Or gold mine at Grace Lake is located 800 m southwest of the fault.

The fault at Bobarris Lake is associated with intense alteration and sulphides associated with localized, anomalous, gold mineralization. Beakhouse (1989) noted that quartz vein systems associated with faults in the Birch Lake area lie outside the zones of strong shearing, at the margins of the fault zones. Therefore, there may be gold potential in a fairly wide area around the fault. The fault is also well defined by magnetic lows indicated on recent airborne geophysical maps (OGS 1991a). Several weak airborne electromagnetic conductors, which may indicate areas of disseminated sulphides, occur within or adjacent to the magnetic lows (OGS 1991b). Most of the ground in the vicinity of the fault was open for staking at the time of writing. The portion of the fault at Bobarris Lake, including the gold occurrence discovered by Explorco Properties Inc., is also open for staking.

BIRCH LAKE—EXIT BAY AND SOUTH BAY AREA

The Exit Bay and South Bay area is situated in the southwest part of Birch Lake. Both bays are accessible from the main body of Birch Lake by a wide north-trending channel.

The Exit Bay–South Bay area is underlain dominantly by a thick sequence of clastic metasedimentary rocks consisting of polymictic conglomerate, arenite, wackes and siltstone intercalated with subordinate intermediate to felsic metavolcanic pyroclastic rocks and mafic metavolcanic flows. The metasediments are intruded by numerous small, feldspar and quartz-feldspar porphyry plugs and stocks and by gabbro sills. The metasediments are interpreted to be part of the Cycle III metavolcanic sequence (Thurston 1986).

A narrow, east-trending, high strain zone extends along the south shore of the entrance into Exit Bay and extends west through the north part of South Bay. East-trending synclinal and anticlinal fold axes have also been delineated in the area (Beakhouse et al. 1989).

Gold mineralization in the area occurs within: 1) east- and northeast-trending, carbonatized and sulphide-bearing shear zones in fine-grained, magnetite-rich, clastic metasediments; 2) deformed felsic and mafic intrusions; and 3) in shear zones located at lithologic contacts between metavolcanic and metasedimentary rocks. Gold is commonly associated with iron carbonate, chlorite and sericite alteration and with sulphides such as pyrite, arsenopyrite, pyrrhotite and chalcopyrite.

The most significant gold properties in the area, such as the Greencamp prospect and Hanson occurrence, are associated with felsic intrusions. The Horseshoe Island prospect, situated north of the Greencamp prospect, consists of low grade gold mineralization associated with a granodiorite intrusion. These intrusions host widespread, low grade gold with high tonnage potential.

The presence of competent, felsic intrusions in less competent metasediments has localized deformation, so that the intrusions and adjacent metasediments are fractured and sheared, providing structural traps for the deposition of gold mineralization. Localization of deformation also results in the development of shear zones at lithologic contacts between less competent metasediments, and more competent intermediate to felsic metavolcanic rocks, such as at the Wagner-Melanson prospect located southwest of Wagner Bay of Birch Lake.

Felsic intrusions associated with gold at the Greencamp and Hanson prospects are expressed as oval, magnetic highs on recent airborne geophysical maps (OGS 1991c). There is very good correlation between the magnetic highs and known intrusions indicated on geological maps (Beakhouse et al. 1989; Good et al. 1986). Therefore, it is possible that similar magnetic highs on the geophysical maps indicate the presence of unidentified intrusions, which maybe associated with sulphides and gold.

Several, round, magnetic highs are situated immediately north of Exit Bay where felsic intrusive rocks have been mapped (OGS 1991c; Beakhouse et al. 1989). A large magnetic high, associated with coincident airborne electromagnetic conductors, is located at the extreme east end of Exit Bay, where an outcrop of gabbro has been mapped (OGS 1991c; Good et al. 1986). Several small oval magnetic highs occur along the south shore of Wagner Bay of Birch Lake (OGS 1991c, 1991d). The airborne magnetic maps delineate several well defined lithologic contacts which may also represent potential areas of deformation associated with gold.

Prospecting for gold associated with felsic and mafic intrusions should be concentrated in the Exit Bay–South Bay area of Birch Lake. Correlating recent airborne magnetic maps with geological preliminary maps may be useful in detecting unexplored intrusions.

SWAIN LAKE DEFORMATION ZONE

The Swain Lake Fault and/or deformation zone (SLDZ) is one of the most prominent structures in the Birch–Confederation–Uchi lakes greenstone belt (*see* Figure 3.6). The deformation zone extends east-southeast from Leonard and Shabu lakes (Pryslak 1974), at the west margin of the belt, where it bisects metavolcanic and metasedimentary assemblages. The SLDZ arcs to the northeast, at the north end of Woman Lake, and extends along the northwest shore of Swain Lake (Fyon and O'Donnell 1986). The SLDZ terminates in the southwestern part of Birch Lake on Western Peninsula, where it bifurcates into several, east-northeast-trending splays (*see* Figure 3.6; Beakhouse et al. 1989). The SLDZ intersects mafic to felsic metavolcanic rocks, metasediments and intrusive rocks and commonly occurs along significant lithologic contacts.

The SLDZ has an approximate strike length of 24 km and varies in width from 1 to 3 km (Fyon and Lane 1986). Beakhouse (1989) determined that the SLDZ has a dextral, horizontal, component and a northwest-side-up, vertical component at Birch Lake.

Intense alteration consisting of sericitization, chloritization, iron carbonatization and pyritization is associated with zones of strong planar fabric and shearing in the SLDZ. Associated quartz vein systems commonly occur outside the zones of strong shearing but within zones of irregular or anastamosing fabric. The quartz veins are commonly crack-seal type, hosting iron carbonate, tourmaline and sulphides. Several significant gold properties are situated within or near the SLDZ. The Horseshoe Island gold prospect at Birch Lake is situated within an east-trending splay of the SLDZ. The prospect consists of pervasive, intense and widespread alteration associated with abundant disseminated sulphides in intermediate metavolcanic host rocks and a granodioritic intrusion (Beakhouse 1989; Parker and Atkinson, in press). St. Joe Canada Inc. has outlined 893 508 tons grading 0.14 ounce Au per ton (*George Cross News Letter*, Dec. 20, 1989, p.3) at the prospect.

Noramco Explorations Inc. discovered several areas of anomalous gold and sulphide mineralization, associated with iron carbonate alteration and silicification, within the SLDZ near Woman, Washogomis, Mosier and Swain lakes. Gold is also associated with the SLDZ at Leonard Lake (previously described in this report) and at the Price–Logan occurrence at Car Lake. The Price-Logan occurrence consists of a quartz-carbonate vein system within a 15 m wide shear zone striking 075° (Parker and Atkinson, in press).

Noranda Exploration Company Ltd. recently discovered gold mineralization along a northeast-trending splay of the SLDZ on Western Peninsula of Birch Lake. The gold-bearing zones consist of gossan-stained, sericitized and silicified, felsic pyroclastic rocks containing 1% to 4% disseminated pyrite. Numerous gold values ranging from trace to 21.0 g/t Au and 0.61 ounce Au per ton have been obtained from the mineralized zones.

Labrador Exploration (Ontario) Ltd. in 1983 discovered gold-bearing quartz veins in the vicinity of the SLDZ at Southwest Bay of Birch Lake. Samples taken from pyritic, crack-seal veins at this occurrence have assayed as high as 12.73 ounces Au per ton and 1.77 ounces Ag per ton. Samples taken from sulphide-bearing host rocks adjacent to the veins analyzed 200 ppb Au and 0.04 ounce Au per ton (Beakhouse 1989).

The abundance of alteration, sulphide and gold mineralization associated with the SLDZ at numerous locations along its strike length, indicates that it is a significant prospecting target for gold. Areas of unstaked ground along the strike and width of the SLDZ should be carefully prospected for quartz veins and silicified zones in intensely altered pyritic rocks. Gold may be associated with other intermediate to felsic intrusions within the SLDZ in a geological setting similar to the Horseshoe Island prospect. Recently published airborne geophysical maps (OGS 1991a) may assist in identifying unmapped intrusive bodies within the SLDZ.

PROPERTY EXAMINATIONS

Gold Occurrences and Prospects

Gold occurrences and prospects in the Red Lake and Birch–Confederation–Uchi lakes greenstone belts were examined by the staff of the Red Lake Resident Geologist's office. Several gold properties are described below.

J. WILLIAMSON–BELANGER TOWNSHIP OCCURRENCE

The Williamson–Belanger occurrence is situated on the northeast corner of Belanger Township. Claims KRL 1107630, 1107631, 1107651 and 1107751 staked by J. Williamson in 1990 encompass the occurrence. A secondary logging road provides direct access to the property from the South Bay Mine Road.

The occurrence includes 2 separate mineralized zones discovered by J. Williamson during prospecting in the area in 1988. The most westerly showing is situated on the west side of a small pond covered by claim KRL 1107751. Mineralization is confined to a 2 m wide, east-trending shear zone in mafic metavolcanic flows that are intruded by a feldspar porphyry dike. Chalcopyrite and possibly cuprite occur in the dike while chalcopyrite and pyrite occur as thin seams parallel to shearing in the mafic flows.

The east showing is covered by claim KRL 1107632 and has been recently stripped and blasted by J. Williamson. The main stripped area exposed several sheared 1 to 2 m wide quartz porphyry dikes that intrude a medium-grained body of gabbro. Shearing both in the dikes and the enclosing wallrocks trends 040° to 060° and dips moderately to steeply northward. Mineral lineations plunge 010°/50°N. The terminations of the dikes

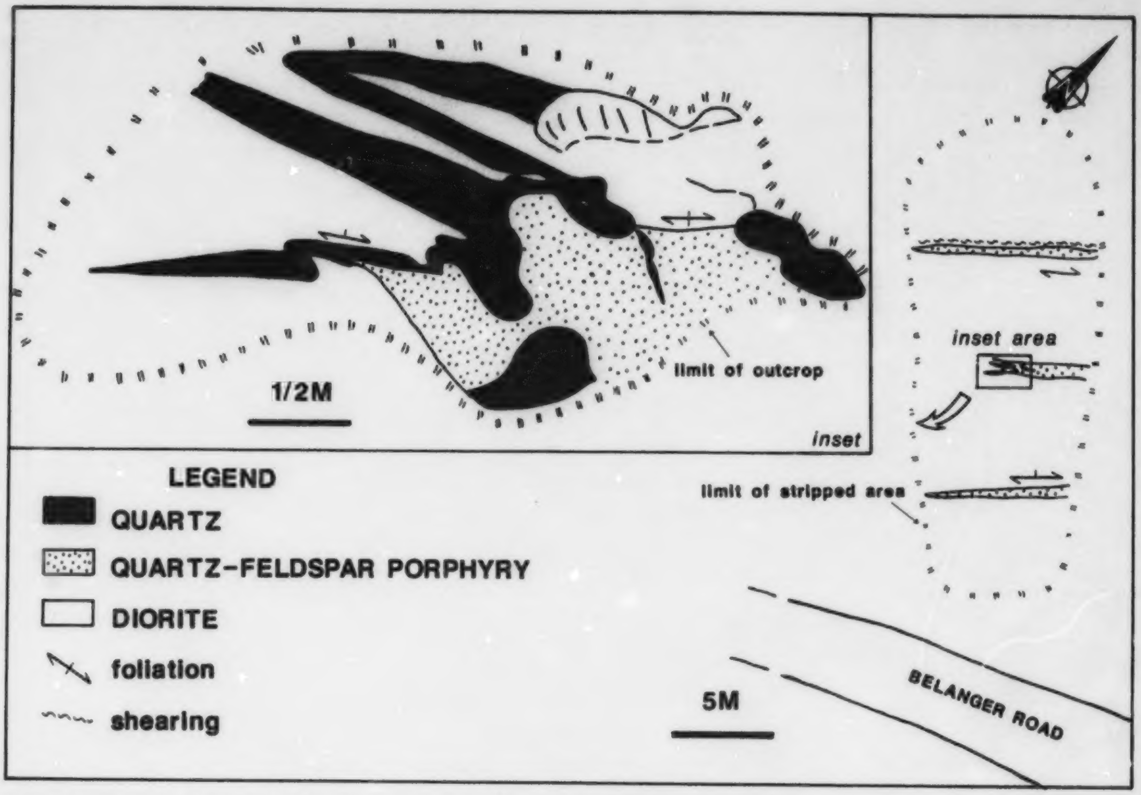


Figure 3.7. Detail geology of the J. Williamson–Belanger Township occurrence.

are exposed in the strippings and are the loci for quartz veining and accompanying mineralization, as illustrated in Figure 3.7. Pyrite, chalcopyrite and rare native copper occur in and adjacent to the quartz veins; values up to 0.80 ounce Au per ton are reported by J. Williamson. Samples collected by the authors ranged from less than 2 ppb Au to 0.46 ounce Au per ton (Geoscience Laboratories Section, Ontario Geological Survey, Toronto).

REDRUTH NO. 3A VEIN—BAIRD TOWNSHIP

The Redruth property is located in north-central Baird Township, access to the property is by rough drill trail that leads from Highway 618 at the Red Lake Buffalo Mine. The property was originally comprised of 21 patented claims in Baird Township and 2 adjoining patented claims in Fairlie Township. Work on the property up to 1952 is described by Ferguson (1965). Since that time, the only reported work done was by Redaurum Red Lake Mines Ltd. between 1984 and 1986. Redaurum did power stripping, geological mapping, sampling and diamond drilling on the property. The exploration program resulted in the discovery of the No. 3A Vein, east of earlier discovered auriferous veins on claims KRL 18486 and 18681 (Figure 3.8).

The No. 3A vein consists of fine-grained, sugary quartz and varies in width from 15 to 60 cm, it is persistent over a strike length of 120 m. The vein is oriented at 344° and dips steeply to vertically. The No. 3A Vein is hosted by medium-grained hornblende-bearing gabbro. Both the gabbro intrusion and the No. 3A quartz vein terminate against iron-carbonate altered, pillowed mafic flows to the south. The northward extent of the vein and gabbro is obscured by overburden.

An east-trending fault has caused a 10 m westward displacement on the vein. The northward orientation of the No. 3A Vein contrasts with the west-northwest orientation of other veins on the property. Although atypical of veining elsewhere on the Redruth property, the No. 3A Vein bears many similarities to quartz veining on the Alcourt property located 7 km to the north (*see* Atkinson and Storey 1988). Vein similarities include host rocks, vein size, orientation, displacement sense and style of mineralization; both are auriferous. Further, these veins are colinear, they may be emplaced along a single major northwest-trending gold-bearing structure.

Mineralization in the No. 3A vein includes pyrite and chalcopyrite; gold values up to 1.56 ounce Au per ton are reported. Rare crack-sealing black tourmaline and green fuchsite colour the quartz at the north end of the vein.

NAVEAU ISLAND OCCURRENCE

The Naveau Island occurrence is situated on the east shore of

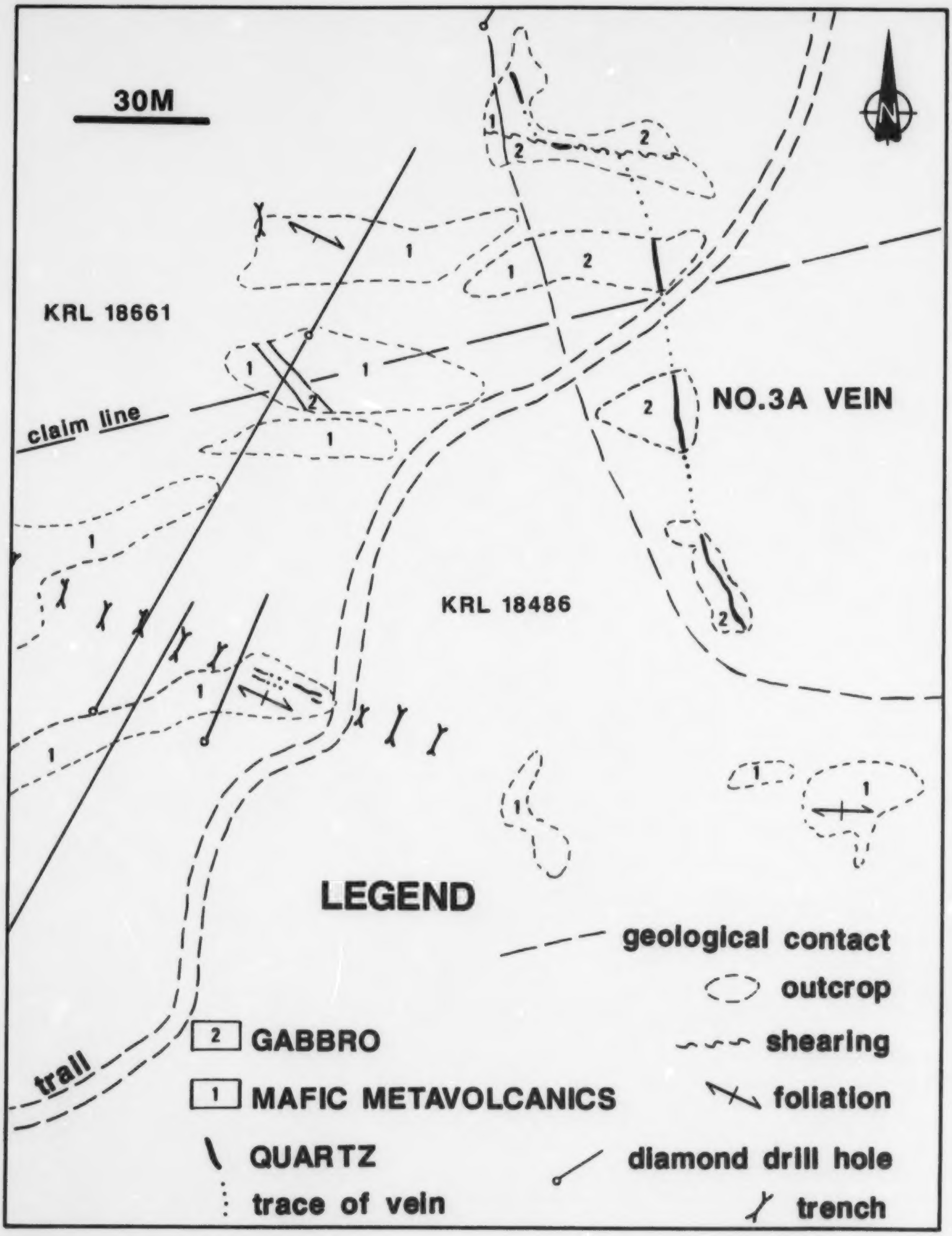

30M
KRL 18661
KRL 18486
claim line
NO.3A VEIN
trail
N
1
2
LEGEND
geological contact
outcrop
shearing
foliation
diamond drill hole
trench
2 GABBRO
1 MAFIC METAVOLCANICS
QUARTZ
trace of vein

Figure 3.8 Geology of the Redruth No. 3A Vein, Baird Township.

Naveau Island (local name) on Woman Lake in Dent Township. The island is located at the common boundary between Dent and Goodall townships.

The area in the vicinity of the occurrence has been explored for gold since 1926. In 1970 Midland Nickel Corp. Ltd. (Canex Aerial Exploration Ltd.) conducted airborne electromagnetic surveys over the property and diamond drilled one hole targeted on an electromagnetic conductor at the southwest end of Naveau Island. Orofino Resources Ltd. staked the ground in 1983 and flew airborne geophysical surveys over the area. In 1986 Orofino conducted geological mapping and humus geochemical surveys which were followed by magnetic and electromagnetic ground geophysical surveys, trenching, stripping and sampling in 1987.

The occurrence is situated within the north- and northeast-trending Rowe–Woman lakes deformation zone which consists of several discrete shear zones up to 10 m wide (Fyon and Lane 1986). The deformation zone also hosts the Jackson–Manion North gold occurrence situated about 5 km south of Naveau Island.

The occurrence is hosted within north-trending, intermediate to mafic, metavolcanic flows and pyroclastic rocks with subordinate interflow metasediments. The metavolcanic rocks are intruded by gabbroic to dioritic sills and dikes (Pryslak 1970a). The metavolcanic and metasedimentary rocks are part of the Cycle III metavolcanic sequence (Thurston 1985).

The occurrence consists of a north-trending, quartz vein composed of discontinuous quartz lenses up to 0.6 m wide which are situated along the footwall of a black, graphitic, argillaceous iron formation containing up to 15% disseminated pyrite. The quartz vein lenses have been traced for a strike length of 15 m and contain minor disseminated pyrite and up to 3% galena and 2% chalcopyrite. The quartz vein is hosted by aphanitic, pale grey-green, soft, carbonate-rich metasediments which weather buff grey or brown. The metasediments contain veinlets of crystalline, pale grey carbonate. The metasediments are interlayered with intermediate tuffs which are sericitized, sheared 040° and contain numerous small black-green "spots" which are less than 2 mm in size. A well developed set of joints or fractures trending 004° occur within the intermediate tuffs.

A grab sample taken from the occurrence by Orofino Resources Ltd. assayed 1.09 ounces Au per ton and 0.48 ounce Ag per ton. Additional sampling gave gold values up to 245 ppb Au. Sampling of intermediate metavolcanic wall rocks gave gold values ranging between 25 and 70 ppb Au.

PHILLIPS OCCURRENCES (JEROME, A. OCCURRENCES)

The Phillips occurrences consist of 3 separate gold showings located along the west side of Phillips Channel at the west end of Red Lake in Ball Township. The first gold occurrence is located on the west side of Phillips Channel at the entrance to Pipestone Bay of Red Lake. A second occurrence is located on a point of land on the north shore of Middle Bay at the entrance into Phillips Channel. The third gold showing is located on a T-shaped point of land on the south shore of Middle Bay at the entrance into Phillips Channel.

The occurrences were staked by B. Phillips prior to 1930 and consisted of 2 separate groups of claims. The north group consisted of 6 claims centered on Phillips Channel at the entrance into Pipestone Bay. The south group consisted of 3 claims situated along the south shore of Middle Bay at the entrance into Phillips Channel. Some trenching and sampling was conducted during 1930 on the properties but gold values were erratic and difficult to duplicate. Sampling and mapping was conducted on the south group of claims at Middle Bay by Erie Canadian Mines Limited in 1935.

The south group of claims were acquired by I. Kornell who diamond drilled 1 hole on the property to 204 m in 1961. The south group of claims were restaked by W. Stupack who diamond drilled 8 holes, totalling 267 m, between 1961 and 1969.

Cochenour Willans Gold Mines Ltd. acquired the north group of claims in 1963. The company diamond drilled 15 holes totalling 620 m on the property between 1964 and 1968. Cochenour Willans optioned W. Stupack's claims on the south shore of Middle Bay in 1963 but no work was reported.

The claims were staked by A. Jerome in 1980 and optioned to Gold Fields Resources Canada Ltd. who conducted geophysical surveys over the north part of the claims.

The occurrences were staked by A. Sanderson and transferred to J. Green in 1984 and optioned to Shane Resources Ltd. in 1986. Shane Resources conducted rock and soil sampling, geological mapping and ground magnetic and electromagnetic geophysical surveys between 1986 and 1987. The company diamond drilled the occurrences with 3 holes totalling 434 m in 1988. The claims lapsed in 1991 and were subsequently restaked by A. Maciejewski.

The Phillips occurrences are situated within east-trending, mafic, metavolcanic flows intercalated with felsic flows and pyroclastic rocks and intruded by ultramafic rocks of the Pipestone Bay stock and felsic dikes and sills (Riley 1975). The metavolcanic rocks are part of the Ball calc-alkalic sequence (Pirie 1981). The occurrences are situated in the vicinity of 2 small, west-northwest-trending deformation zones at Middle Bay (Durocher et al. 1987).

The gold occurrence located on the west side of Phillips Channel, at the entrance to Pipestone Bay, occurs within ultramafic rocks of the Pipestone Bay stock. The ultramafic rocks contain large rafted inclusions of mafic and felsic metavolcanic rocks and are intruded by felsic, porphyritic dikes. The ultramafic rocks are intensely iron carbonatized and talcose and occur within a 60 m wide zone of alteration that extends along the south shore of Pipestone Bay. The alteration zone is subparallel to a northeast-trending foliation (Durocher et al. 1987). The ultramafic rocks host fine-grained, disseminated pyrite and narrow, white, quartz stringers which have been reported to contain visible gold. Channel samples taken across the altered zone by B. Phillips assayed as high as 1.87 ounces Au per ton across 1.8 m while several grab samples assayed between 0.01 and 1.88 ounces Au per ton.

Diamond drilling conducted at the occurrence by Cochenour Willans Gold Mines Ltd. and Shane Resources Ltd. intersected carbonatized, garnetiferous, talcose, ultramafic rocks which were variably silicified, pyritic, chloritic and contained numerous, narrow, quartz stringers. No gold values were reported from the diamond drilling.

The gold occurrence located on a point of land on the north shore of Middle Bay, at the entrance into Phillips Channel, occurs within east-trending, mafic, metavolcanic flows intercalated with felsic flows and pyroclastic rocks. A very massive, siliceous, nondescript grey rock has been exposed by stripping at the occurrence, but very little sulphides or alteration was noted by the second author. In 2 spearate drill holes at the occurrence, diamond drilling conducted by Cochenour Willans Gold Mines Ltd. intersected: 1) 0.27 ounce Au per ton across 0.6 m and 0.06 ounce Au per ton across 0.6 m, and 2) 0.24 ounce Au per ton across 0.45 m and 0.05 ounce Au per ton across 1.1 m. Gold mineralization was intersected in an intensely silicified and sericitized quartz porphyry containing numerous quartz stringers, disseminated pyrite and minor sphalerite. Diamond drilling also intersected talcose ultramafic rocks and variably silicified and chloritic, mafic metavolcanic flows.

The third gold occurrence, located on a T-shaped point of land on the south shore of Middle Bay at the entrance to Phillips Channel, is hosted by east-trending, mafic, metavolcanic flows intercalated with porphyritic, felsic flows and pyroclastic rocks. Stripping at this occurrence has exposed a fine-grained, felsic, quartz porphyry which is strongly sheared at 286°, intensely sericitized, chloritic and gossan-stained. The felsic rock contains disseminated pyrite as well as numerous discontinuous seams and stringers of pyrite. Black tourmaline occurs on fractures and in narrow veinlets and numerous dark green to black clots, which are less than 1 mm in size, are scattered throughout the felsic rock. Intensely carbonatized mafic metavolcanic rocks, hosting variable amounts of quartz stringers, occur adjacent to the altered felsic rocks. A grab sample taken by Shane Resources Ltd. from the altered mafic flows assayed 0.55 ounce Au per ton.

About 100 m east along the lake shore a 0.6 m wide, silicified and pyritic shear zone, striking 290°, is hosted by garnetiferous, magnetite-rich, ultramafic rocks in contact with grey, felsic, metavolcanic rocks. Another narrow shear zone at this location strikes 124°/85°NE and hosts a narrow quartz vein. A grab sample taken from the silicified shear zone by A. Maciejewski assayed 0.14 ounce Au per ton (A. Maciejewski, Prospector, personal communication, 1991).

Diamond drilling conducted by W. Stupack, I. Kornell and Shane Resources Ltd. at the occurrence intersected altered, felsic metavolcanic rocks hosting quartz-carbonate veins alternating with narrow units of altered mafic rocks. Scheelite was reported in the felsic rocks in a hole diamond drilled by I. Kornell.

Base Metal Occurrences and Prospects

Base metal occurrences and prospects in the Birch–Confederation–Uchi lakes greenstone belt were examined, during the third year of an ongoing study of base metal mineralization in the western Uchi Subprovince, by the staff of the Red Lake Resident Geologist's office. Several base metal properties are described below.

MASKOOCH LAKE OCCURRENCE

The Maskooch Lake occurrence consists of 2 small test pits and a stripped area situated at the southeast end of Maskooch Lake in the Avis Lake claim map area. Maskooch Lake is a small, northwest-trending lake located 3.2 km due east of Slate Lake. The property is accessible from a skidder trail which extends southeast from the Wenasaga Road, about 65 km northeast of Ear Falls.

Noranda Exploration Company Ltd. conducted electromagnetic and magnetic surveys over their claims at the east end of Maskooch Lake in 1969, but the claims were subsequently cancelled.

In 1977 the Maskooch Lake area was staked by St. Joseph Explorations Ltd. who conducted horizontal loop electromagnetic and magnetic ground geophysical surveys over the property. St. Joseph Explorations diamond drilled electromagnetic conductors north and west of Maskooch Lake in 1979.

Getty Canadian Metals Ltd. in 1983 conducted a regional airborne geophysical survey over the area and limited magnetic and electromagnetic ground geophysical surveys, as well as trenching, geological mapping and humus and lithogeochemical sampling in the vicinity of Maskooch Lake.

Noranda Exploration Company Ltd. staked the Maskooch Lake area in 1985 and discovered Getty's test pits sunk on chalcopyrite showings at the southeast end of Maskooch Lake, during reconnaissance mapping and lithogeochemical sampling. In 1986 Noranda conducted horizontal loop electromagnetic and magnetic geophysical surveys and detailed geological mapping.

In 1989 the occurrence was staked by L. Rosenthal who conducted sampling and a self potential geophysical survey over the property. The occurrence was restaked in 1991 by J. Williamson who conducted stripping, trenching and sampling.

The Maskooch Lake occurrence is situated on the south flank of an east-trending synclinal fold axis (Bowen 1989a, 1989b). East-trending, intermediate to felsic pyroclastics and flows are intercalated with subordinate mafic metavolcanic flows. Narrow, discontinuous units of recrystallized and brecciated chert-magnetite-sulphide iron formation are situated along the contacts between mafic flows and felsic pyroclastic rocks. The supracrustal rocks are intruded by the Maskooch Lake stock which consists of quartz-feldspar porphyry (Bowen 1989a). The stock is granodioritic where it is exposed at the Maskooch Lake occurrence, however, the stock is more felsic and porphyritic in outcrop exposures on Maskooch Lake.

A sample taken by R.P. Bowen (1989a, 1989b) from the stock, at its south contact with felsic metavolcanic rocks, was found to contain 0.5 to 2.5 mm, poikiloblastic, twinned laths of chloritoid in a quartz-sericite matrix. The sample was reported to consist of 7% to 10% chloritoid, 40% quartz and 40% to 45% sericite with 2% to 3% Fe-Ti oxides. The presence of chloritoid in the contact zone is indicative of hydrothermal alteration (Bowen 1989a).

Disseminated chalcopyrite, pyrite, pyrrhotite and magnetite are hosted by sheared, intermediate to felsic pyroclastic rocks and siliceous metasediments near the contact of the Maskooch Lake stock. Metavolcanic host rocks exposed in the test pits are gossan-stained, biotitic, sericitized and contain up to 5% disseminated sulphides. Sulphides occur in narrow, discontinuous seams, layers and fractures and are interstitial to brecciated fragments of host rock. Semi-massive lenses of sulphides contain fragments of siliceous host rocks and quartz. Banded sulphides consisting of pyrite nodules, chalcopyrite and pyrrhotite occur within a layered siliceous rock exposed in one of the test pits. The host rocks also contain garnet crystals less than 1 mm in size. Metavolcanic rocks are strongly foliated at 260°. Recent stripping and trenching in the vicinity of the old test pits has exposed a 4.5 m wide mineralized zone hosting small, discontinuous pods and lenses of massive pyrrhotite and chalcopyrite.

Metavolcanic rocks in the vicinity of the occurrence consist of intermediate to felsic lapilli tuff and tuff breccia with very siliceous clasts in a more mafic matrix. Some of the pyroclastic units appear to be variably silicified.

Sulphides occur in folded, amphibolitized, garnetiferous mafic rocks situated about 400 m southeast of Maskooch Lake. The sulphides consist of disseminated pyrite, chalcopyrite and pyrrhotite. Abundant disseminated chalcopyrite mineralization occurs within sericitized felsic metavolcanic rocks along the southwest shore of Maskooch Lake.

A sample taken from the test pit at the occurrence by Getty Canadian Metals Ltd. analyzed 320 ppb Au and 0.41% Cu. Two chip samples assayed 0.43% Cu across 1 m and 0.30% Cu across 2.5 m. A sample taken by Noranda Exploration Company Ltd. assayed 0.091 ounce Au per ton.

Three grab samples taken by the second author from the test pits analyzed 32 ppb Au, 1995 ppm Cu and 102 ppm Zn; 880 ppb Au, 0.76 ounce Ag per ton, 915 ppm Cu and 137 ppm Zn. A grab sample taken from the sulphide-rich mafic rocks located 400 m southeast of Maskooch Lake analyzed 2050 ppb Au, 500 ppm Cu and 165 ppm Zn. Four samples taken by the second author from sericitized, chalcopyrite-bearing, felsic metavolcanic rocks situated along the southwest shore of Maskooch Lake analyzed 11 ppb Au, 380 ppm Cu and 42 ppm Zn; 410 ppb Au, 1% Cu and 87 ppm Zn; 2940 ppb Au, 0.32 ounce Ag per ton, 1.18% Cu and 98 ppm Zn; and 385 ppb Au, 9500 ppm Cu and 80 ppm Zn (Geoscience Laboratories Section, Ontario Geological Survey, Toronto).

BORGFORD LAKE OCCURRENCE

The Borgford Lake occurrence is situated on the north shore of Borgford Lake which is 1.0 km west-northwest of North Bay of Confederation Lake in Dent Township. The occurrence is located on the west side of the creek which flows north from Borgford Lake. The property is accessible from a winter road trail which extends northwest from the west shore of Confederation Lake.

The Borgford Lake occurrence is 250 m due west of the Hudson-Patricia Mine which is a former gold producer in the Birch–Confederation–Uchi lakes greenstone belt. Much of the area around Borgford Lake was staked by St. Joseph Exploration Ltd. during the mid-1970s. St. Joe was exploring for gold in the vicinity of the Hudson–Patricia Mine and had conducted various ground electromagnetic and magnetic geophysical surveys, geological mapping, trenching, rock and soil sampling and diamond drilling from 1974 to 1981.

In 1988 Gold Crest Minerals Inc. conducted magnetic and electromagnetic geophysical surveys, geological mapping and some sampling on the property.

North-trending, massive and pillowed, amygdaloidal, mafic metavolcanic flows are intercalated with intermediate flows and pyroclastic rocks and intruded by gabbroic, granodioritic and porphyritic, felsic sills and dikes in the vicinity of the occurrence (Pryslak 1970a). The metavolcanic rocks are part of the Cycle III metavolcanic sequence which hosts much of the base metal mineralization in the Confederation Lake area, including the South Bay copper-zinc-silver mine (Thurston 1985). A weak to moderate, north-trending, steeply dipping foliation is developed in the vicinity of the occurrence. The occurrence is situated on the west flank of a north-trending synclinal fold axis located east of North Bay of Confederation Lake (Fyon and Lane 1986).

The Borgford Lake occurrence is a 1.5 m wide sulphide zone consisting of layers of sphalerite, chalcopyrite and pyrite with some pyrite nodules. Lapilli to tuff breccia size, subangular clasts of siliceous, dark grey material occur amongst the sulphides. The sulphide zone is hosted by a relatively well sorted but poorly bedded, intermediate to felsic, lapilli tuff consisting of rhyolitic clasts in a matrix composed dominantly of feldspar and quartz crystal shards which are less than 3 mm in size. St. Joseph Exploration Ltd. indicated that the sulphide zone was situated at a north-northeast-trending contact between felsic lapilli tuff and intermediate tuff and flows, but the second author only recognized one rock type hosting the sulphide zone. Pillowed and amygdaloidal mafic flows occur on either side of the lapilli tuff unit.

A diamond-drill hole completed by St. Joseph Exploration Ltd., and targeted on the sulphide zone, intersected alternating units of felsic lapilli tuff and intermediate flows and tuffs. The felsic lapilli tuff was found to host up to 20% disseminated pyrite and 2% chalcopyrite associated with abundant chlorite alteration. St. Joseph Exploration also reported "spherulitic structures" in the tuff. The best assays intersected in the diamond drill hole were 0.02% Zn across 6.8 m and 0.31% Zn and 0.21% Cu across 0.76 m.

Grab samples taken from the sulphide zone by St. Joseph Exploration Ltd. assayed 12.9% Zn, 1.8% Cu, 0.51% Pb, 0.01 ounce Au per ton and 2.79 ounces Ag per ton. A grab sample taken by Gold Crest Minerals Inc. assayed 1.08% Zn, 0.26% Cu, 0.05% Pb, 0.023 ounce Au per ton and 2.0 ounces Ag per ton.

JIG OCCURRENCE

The Jig occurrence is located 600 m due north of Confederation Lake Narrows at the extreme southwest end of Confederation Lake in Mitchell Township.

Gold exploration had been conducted in the vicinity of the prospect since 1926 but the property was staked for its base metal potential in 1969 by Selco Exploration Co. Ltd. after the company had completed airborne geophysical surveys over the area. Selco conducted electromagnetic and magnetic ground geophysical surveys, geological mapping and diamond drilled 8 holes totalling 105 m in 1969 and 1970. The occurrence was staked by G. Desmeules in 1991.

The occurrence is situated within a complex assemblage of intermediate to felsic pyroclastic rocks intercalated with mafic metavolcanic flows and subordinate, carbonate-rich metasediments, argillite, wacke and chert. The metavolcanic and metasedimentary rocks are intruded by numerous small, granitic and gabbroic to dioritic plugs and sills as well as feldspar and quartz-feldspar porphyry dikes and sills. The Jig occurrence is 400 m due south of the contact between the metavolcanic rocks and granitic rocks of the Trout Lake granitoid complex (Pryslak 1970b). The metasedimentary rocks at the Jig occurrence are part of the Cycle III metavolcanic sequence (Thurston 1985).

A strong, east-northeast-trending, steeply dipping foliation is developed in the vicinity of the occurrence. The occurrence is situated within the Confederation Lake Narrows deformation zone (Fyon and Lane 1986) where very strong, east-northeast-trending shearing extends along the north shore of the narrows within intermediate to felsic pyroclastic rocks. The orientation of rock units in the vicinity of the occurrence suggests that the rocks may be tightly folded (Pryslak 1970b). The sheared rocks are commonly pyritic, gossan-stained, sericitized and variably silicified (Fyon and Lane 1985, 1986).

The carbonate-rich metasediments at the Jig occurrence have been skarnified and consist of an assemblage of fine-grained, green diopside, fibrous green actinolite, red to pink garnet and magnetite. Intrusions of chloritic rock and banded, chert-magnetite layers occur throughout the skarn. The skarnified rocks occur as discontinuous lenses adjacent to small granitic and gabbroic intrusions. Fine-grained wacke and argillaceous metasediments are chloritized and biotitic and contain some small amounts of garnet. Mafic metavolcanic rocks are variably garnetiferous and commonly contain interflow units of chert. The majority of the rocks in the vicinity of the occurrence are variably epidotized.

Diamond drilling conducted by Selco Exploration Co. Ltd. intersected numerous, narrow, mineralized sections containing up to 50% sulphides consisting dominantly of pyrite and pyrrhotite with minor chalcopyrite and sphalerite. The sulphides are commonly hosted by carbonate-rich, fine-grained, metasediments containing variable amounts of biotite, chlorite, garnet and graphite. Rock descriptions in the diamond-drill logs suggest that some of the sulphides may have been intersected in skarnified metasediments. Sulphides were also observed in narrow units of intermediate to felsic tuff and in chloritic rhyolite.

The second author did not observe sulphides in the skarnified rocks or metasediments, although disseminated pyrite commonly occurs throughout the intermediate and felsic pyroclastic rocks. A sulphide showing is situated near the northwest corner of a small pond about 300 m inland from Confederation Lake. The showing consists of disseminated pyrite and pyrrhotite in strongly foliated, aphanitic, felsic rock which weathers buff brown and is hematite stained.

GEOLOGICAL DATA INVENTORY FOLIOS

Compilation of Geological Data Inventory Folios (GDIF) for the Red Lake Resident Geologist's District commenced during 1990 with the completion of the GDIF for the Casummit Lake area. In 1991, L. Kosloski, on a Development Opportunity funded by the Employment Equity Fund, continued compilation of the GDIF's. The Geological Data Inventory Folios provide a map-based index, not only to assessment files in the Red Lake Resident Geologist's office, but to all other available mineral-related data in the area of coverage. By the end of 1991, 8 GDIF's were completed and available for viewing at the Red Lake Resident Geologist's office (Figure 3.2).

The GDIF's were completed in the Birch–Confederation–Uchi lakes greenstone belt, which is an historic gold camp that has seen renewed exploration activity in the last decade. The GDIF's cover the NTS areas of 52N/07, 52N/08 and 57N/09. These NTS areas include Casummit Lake, Brownstone Lake, Keigat Lake, Little Shabumeni Lake, Satterly Lake, Seagrave Lake, Shabu Lake and Shabumeni Lake, which have been the scene of intensive gold exploration. The GDIF coverage corresponds with a larger area that was recently encompassed by airborne geophysical surveys contracted by the Ontario Geological Survey (OGS 1991a).

DIAMOND-DRILL CORE STORAGE PROGRAM

The Kenora diamond drill core library serves 3 of the 6 Resident Geologist's districts in northwestern Ontario: Kenora, Sioux Lookout and Red Lake. Core stored consists of core from entire diamond-drill holes from both exploration and mine development diamond drilling, incomplete core recovered from old diamond drill sites, and short samples of core submitted for credit under section 77(6) of the former Mining Act. Although core specimens submitted under section 77(6) are assigned drill hole numbers for inventory purposes, they are not included in Table 3.3 which lists Red Lake drill core stored in the Kenora Drill Core Library.

Gold remained the primary exploration target in the Red Lake district and most of the core collected during 1991 was from gold exploration. The library holds 17 020.8 m of core from 198 diamond-drill holes in the Red Lake district, 13 386.4 m (165 holes) inside the building and 3634.4 m (33 holes) in outdoor storage. During 1991, 1703.5 m of core from 27 holes was collected from the Red Lake district.

Some of the core recovered from storage in Red lake in 1989 was examined during the winter of 1991 and found to be carbonatite material. Four incomplete diamond-drill core sections are from the Carb Lake carbonatite complex, diamond drilled by Big Nama Creek Mines Ltd. in 1968. This is the only carbonatite drill core known to exist from the Carb Lake complex which is located 44 km north-northeast of Red Lake.

Fifteen incomplete diamond-drill sections from the former Copper Lode Mines Ltd. base metal property in Belanger Township were recovered. These holes were diamond drilled between 1965 and 1970, the core had lain in the bush since completion of the diamond drilling. Atkinson et al. (1991) described this deposit in some detail.

There is a renewed interest in base metal mineralization in the Gerry Lake area, west of Belanger Township, and the South Bay Mine area. Core from several properties in these areas are stored in the Kenora Drill Core Library.

Core recoveries from gold deposits in the Red Lake area include core from holes diamond drilled by Minorex Ltd. in 1981 at the Altura Mine in Fairlie Township, core from BHP–Utah Mines Ltd.'s diamond drilling in Todd Township, core

Table 3.3. Summary of core from the Red Lake Resident Geologist's District in the Kenora Drill Core Library

Area	NTS	Company	Holes
Balmer Township	52N/04SE	Eldor Resources Ltd.	3
	52N/04SW	Golden Exploration and Dev. Co.	3
	52N/04SW	Golden Exploration and Dev. Co.	*2
	52N/04SE	Granges Exploration	8
	52N/04SW	Gunnar Gold Inc.	4
Bateman Township	52N/04NE	Penway Explorers Ltd.	9
Belanger Township	52N/15NW	Copper Lode Mines Ltd.	*15
Bruce Lake	52K/14SW	Griffith Mine	8
Buckett Lake	53C/10SW	Rockspan Res. Ltd.	4
Dent Township	52N/02SE	Selco Mining Corp. Ltd.	7
		Sherritt Gordon Mines Ltd.	3
		Silverside Resources Ltd.	3
Dome Township	52N/04SW	Interquest ResourceS	*3
		Sherritt Gordon Mines Ltd.	15
Fairlie Township	52N/04SW	Minorex Ltd.	1
		Minorex Ltd. (Altura Mines)	*2
		Selco Mining Corp. Ltd.	1
		Sherritt Gordon Mines	1
Gerry Lake	52K/14NE	Noranda Exploration Co. Ltd.	1
Grist Lake	53C/04NW	Cominco Ltd.	3
Heyson Township	52N/04SW	Laverty Red Lake Mines Ltd.	4
		Selco Mining Corp. Ltd.	1
		Teck Corporation	6
Karas Lake	52K/14SE	Noranda Inc.	1
		Dixie Joint Venture (Selco)	
Killala Township	52L/16NE	Black Cliff Mines Ltd.	6
Kippen Lake	53G/05SW	Eldor Resources Ltd.	5
Mitchell Township	52N/02SE	St. Joseph Exploration Ltd.	1
	52N/02SE	Noranda Inc.	1
	52N/02SE	Placer Dome Inc.	4
Seagrave Lake	52N/08SE	BP Resources Canada Ltd.	4
Shabu Lake	52N/07SW	Flint Rock Mines Ltd.	6
Shabumeni Lake	52N/07SE	Falconbridge Ltd.	5
		Marilyn Resources Ltd.	4
Slate Lake	52K/15E	Noranda Exploration Co. Ltd.	7
South of Otter Lake	52K/14NW	Noranda Inc.	1
		Dixie Joint Venture (Selco)	
		Lightval Mines Ltd.	4
		Selco Mining Corp. Ltd.	4
Todd Township	52M/01SE	BHP-Utah Mines	3
		BHP-Utah Mines	*2
		Solterman, R.	*3

* indicates core recovered in 1991

from Rene Solterman's property in Todd Township, core from the Headway property in Balmer Township and core from the Interquest Resources Corporation drilling in Dome Township.

RECOMMENDATIONS FOR EXPLORATION

Hornby Lake Greenstone Belt

Geological reconnaissance in the Hornby Lake greenstone belt has identified several areas of exploration interest. The mafic-ultramafic rocks in the west half of the belt have possibilities for komatiitic hosted base metal mineralization. Anomalous copper-nickel values have previously been reported (Atkinson and Storey 1988). Gold potential associated with ultramafic rocks in the Hornby Lake area warrants investigation. Explorers should bear in mind the amphibolite metamorphic grade of the belt and the lack of carbonate alteration. Amphibolite-grade metamorphic assemblages generally contain gold mineralization related to ductile shear zones of narrow width and confined or limited alteration haloes. These generally are difficult to detect and require basic prospecting of shear zones and areas of sulphide mineralization. The east side of the belt consists largely of metasedimentary rocks and a small amount of felsic to intermediate metavolcanic rocks. The contact between the 2 halves of the belt is sharp, linear, strained and mineralized with pyrrhotite and minor chalcopyrite. A number of character samples from previously discovered sulphide occurrences were sampled by the first author but yielded assays of 17 ppb Au or less. Nevertheless, the tectonic setting of an older mafic-ultramafic assemblage against a younger felsic metavolcanic-metasedimentary assemblage is reminiscent of the geological setting of the Madsen Mine in the Red Lake greenstone belt. Highly strained rocks in the contact zone west of Findlay Lake warrant thorough investigation for Madsen type gold mineralization. The Findlay Assemblage harbours a number of sulphide occurrences hosted by felsic metavolcanic rocks. The occurrence of chert magnetite ironstones, now altered to garnet-chert mineral assemblages might represent the exhalative component associated with volcanogenic massive sulphide mineralization. During the present examination, the only aluminosilicate mineral observed with possible volcano- genic massive sulphide implications was sillimanite. It was not determined whether the sillimanite was the product of hydrothermal alteration or a more widespread metamorphic response. However, felsic rocks of the Findlay Assemblage should be considered as a secondary target for base metal mineralization.

Baird Township

Quarter-mile scale mapping of Baird Township during the past field season (Wallace and Atkinson, in press) has identified east-trending shears in the central township area cored by iron carbonate veins. Pervasive iron carbonate alteration emmanates outwards from the veins into the enclosing wall rock that host gold and sulphide mineralization. Properties including the Redaurum, Redruth and Aiken Russet have small diamond-drill-indicated inventories of gold mineralization associated with iron-carbonate altered mafic metavolcanic rocks. The area extending north from Madsen to St. Paul Bay bears remarkable similarities to the Campbell-Dickenson mines area in Balmer Township, site of the current producing mines, and is considered to be some of the highest potential area for economic gold mineralization in the Red Lake greenstone belt.

Table 3.4. Maps and Reports Pertaining to the Red Lake Resident Geologist's District Issued by the Ontario Geological Survey, 1991.

Airborne Geophysical Maps	
81595-81669	Airborne Electromagnetic and Magnetic Survey Birch–Uchi–Confederation Lakes Area
Open File Reports	
OFR 5812	Physical and Chemical Processes of Archean Subaqueous Volcaniclastic Rocks, Ontario
Preliminary Maps	
P.3107	Geology and Gold Mineralization, Red Lake Greenstone Belt
Miscellaneous Paper	
MP 152	Report of Activities 1990 Resident Geologists
MP 156	Geoscience Research Grant Program, Summary of Research 1990–1991
MP 157	Summary of Field Work and Other Activities 1991
Open File Maps	
OFM 176	Geology of the Casummit Lake Area (1:15 840)
Special Volume	Vol. 4, Part 1 Geology of Ontario

Birch–Confederation–Uchi Lakes Greenstone Belt

The Birch–Confederation–Uchi lakes greenstone belt has considerable potential for new gold discoveries with many prospecting targets that remain unexplored. Several areas with gold potential have been described and recommended in previous sections of this report.

Areas of widespread gold mineralization have been identified at Leonard, Woman and Washagomis lakes. Large sections of deformation zones such as the Bobarris Lake fault and the Swain Lake deformation zone remain relatively untested. Both structures are associated with intense alteration, deformation and sulphide and gold mineralization.

The recent airborne geophysical survey completed over the greenstone belt (Barlow 1990; OGS 1991a) has contributed another source of information that can be used to identify potential gold exploration targets. Numerous mining claims have recently come open throughout the greenstone belt due to a recent downturn in gold exploration. As a result, several gold occurrences were open for staking at the time this report was written.

Base Metals

Base metal exploration has continued throughout the south

Confederation Lake area, in the Birch–Confederation–Uchi lakes greenstone belt during the past year. Exploration work has been concentrated in the Snake Falls area, at Fly Lake, at Slate Lake, and southwest of the South Bay copper-zinc-silver mine.

Recent exploration has identified areas of widespread andalusite alteration northwest of Fly Lake. The alteration consists of abundant andalusite knots, up to 2 cm in size, in felsic metavolcanic rocks. Whole-rock geochemistry has shown that the altered rocks dominantly consist of Al_20_3 and $Si0_2$ (G. Glenn, Minnova Inc., personal communication, 1991). This alteration has not previously been recognized in the Fly Lake or South Bay Mine areas, and may be an alteration that has been overlooked in other areas. The andalusite knots could be mistaken in the field as primary structures such as spherulites and rounded lapilli-size clasts.

Chlorite, sericite, anthophyllite, garnet and cordierite are other silicate minerals that have been identified in altered rocks, associated with sulphide mineralization, in the south Confederation Lake area.

Sulphide mineralization is associated with a skarnified marble unit at the Jig occurrence on Confederation Lake. The skarnified marble is part of a stromatolitic limestone unit, associated with chert-magnetite iron formation, located along the east shore of Woman Lake (Thurston 1985). The unit has been traced by mapping, diamond drilling and geophysics for a strike length of approximately 72 km extending north from Woman Lake to Shabu Lake (Pryslak 1970a, 1974), and south to the Dixie 17, 18 and 19 zinc-copper prospects northeast of Pakwash and Bruce lakes. The marble unit is variably skarnified along its strike and commonly consists of fine- to very coarse-grained diopside, actinolite and garnet with accessory calcite and quartz (Atkinson et al. 1991).

Base metal occurrences are spatially associated with the marble-iron formation unit, such as copper-silver occurrences situated at Shabu Lake, the Copper Lode A copper-silver prospect southeast of Fredart Lake, and zinc, copper and silver occurrences at Gerry Lake and at the Dixie 17, 18 and 19 prospects. Diamond drilling by Selco Exploration Co. Ltd., at the Dixie 18 prospect outlined 150 000 tons grading 14% Zn. Reserves of 236 424 tons grading 1.94% Cu and 1.22 ounces Ag per ton have also been outlined at the Copper Lode A property (Atkinson et al. 1991).

The marble unit overlies intermediate to felsic pyroclastic rocks at the top of the Cycle II metavolcanic sequence, which in turn is overlain by Cycle III metavolcanic rocks (Thurston 1985). As stated previously, the marble unit extends southwest from Woman Lake to Gerry Lake, the Copper Lode A prospect and the Dixie 18 prospect, which have been interpreted (Wallace et al. 1986) to be underlain by Cycle III metavolcanic rocks. Since the marble unit occurs at the top the Cycle II sequence, the contact between the Cycle II and Cycle III rocks extends further to the southwest than previously indicated. The break between the 2 cycles represents a period of quiescence in volcanism. The deposition of the marble-iron formation unit may have corresponded with the deposition of sulphides.

Further base metal prospecting should be conducted along the strike of the marble-iron formation unit. Recent airborne geophysical maps (OGS 1991a) may assist in detecting electromagnetic conductors associated with the marble unit.

The Slate Lake area, southeast of Uchi Lake in the Birch–Confederation–Uchi lakes greenstone belt, is another area that may have base metal potential.

Thick sequences of intermediate and felsic pyroclastic rocks are associated with thin units of chert-magnetite iron formation. The metavolcanic sequences alternate with units of fine to coarse, clastic metasediments and mafic metavolcanic flows. Each felsic metavolcanic sequence is intruded by small, granitoid stocks and plutons. Some of the metavolcanic rocks in the area have been assigned to the Cycle II sequence (Bowen 1989a) outlined by Thurston (1985, 1986).

Diamond drilling conducted in the area by St. Joseph Explorations Ltd. between 1977 and 1980, intersected several sections of sulphides consisting dominantly of pyrite and pyrrhotite with minor chalcopyrite and sphalerite. One hole diamond drilled northwest of Slate Lake, near Panama Lake, intersected 4.73% Zn, 0.52% Cu, 0.11% Pb and 1.10 ounces Ag per ton across 0.6 m at a contact between intermediate metavolcanic rocks and metasediments (Bowen 1989a). The Maskooch Lake occurrence east of Slate Lake consists of pyrite, pyrrhotite and chalcopyrite associated with anomalous gold, zinc and silver mineralization, hosted by siliceous, interflow, metasediments and iron formation in dominantly felsic pyroclastic rocks. The presence of chloritoid at the margin of the Maskooch Lake stock is an indicator of hydrothermal alteration (Bowen 1989a), it may be associated with the nearby sulphide mineralization.

More prospecting should be conducted for base metal mineralization in the Slate Lake area, which has been relatively ignored by mineral exploration for the last several years. Bowen (1989b) has mapped several small areas of porphyritic (phenoclastic), pyroclastic rocks with feldspar phenocrysts within the units of felsic metavolcanic rocks. These areas should be checked for andalusite alteration, similar to that previously described at Fly Lake. White to pink, euhedral, andalusite crystals have the appearance of feldspar phenocrysts, especially in felsic pyroclastic rocks, and may be subject to mistaken identity. Andalusite is often related to base metal mineralization at Fly Lake, hence it may serve as an indicator mineral in the Slate Lake area.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

G.P. Beakhouse completed quarter-mile scale mapping in the north part of the Birch lake greenstone belt.

D. Stone continued the third of a multi-year 1:50000 scale mapping of the Berens River Subprovince. Mapping during the current field season was completed on Berens Lake, McInnes Lake, Critchell Lake, Kember Lake, McIntosh Bay, Cherrington Lake and the Ontario portion of Kagipo Lake map sheets.

A contract airborne magnetic and electromagnetic survey of 26 310 line-kilometres was flown over the entire Birch–Confederation lakes greenstone belt for the Geophysics–Geochemistry Section of the Ontario Geological Survey. Results of the survey were released as a set of 75 maps at a scale of 1:20000 with accompanying maps at 1:31 680 scale.

RESEARCH BY OTHER AGENCIES

M. Kalin (Boojum Research Inc.) continued bioengineering studies on mine tailings at the South Bay Mine at Confederation Lake in Dent Township.

B. Carbonneau, Geological Survey of Canada, conducted radiometric studies in the vicinity of the Madsen and Starratt–Olsen mines, Baird Township.

D. Sharpe, Geological Survey of Canada, examined Quaternary geology in the Dixie, Confederation and Slate lakes areas. Till sampling was conducted along all road systems in these areas.

M. Wilson carried out bachelorate studies at the University of Waterloo on the petrology and petrogenesis of the Mink Lake stock.

N. Hopson examined green mica alteration and its relationship to gold mineralization at the Cochenour Willans Mine, Dome Township, as part of Masters studies at University of Western Ontario.

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4. Sioux Lookout Resident Geologist's District—1991

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INTRODUCTION

In 1991, the trend toward reduced exploration activity, which started in 1989, has continued in the Sioux Lookout Resident Geologist's District. Prospectors and mineral-exploration companies conducted about 30 exploration programs in the district during the year. Gold was the target sought after in the majority of the exploration programs. Base metal exploration programs are increasing in frequency, located mainly in the Sturgeon Lake–Savant Lake areas, with some activity occurring in the Pickle Lake area. Figures 4.1a and 4.1b show exploration sites that were worked on in 1991; Table 4.1, which is keyed to Figures 4.1a and 4.1b, provides more detailed information as regards these exploration sites.

One advanced exploration program was active during 1991. Noranda Exploration Company Ltd. optioned Camreco Inc.'s Goldlund Mine property in Echo Township. Noranda Exploration Company Ltd. is exploring the property for both high-grade, low-tonnage and low-grade, high-tonnage potential. Further details on Noranda Exploration Company Ltd.'s exploration program are given in the "Advanced Exploration Activities" section.

Two gold mines were in production within the district at 1991 year's end. The Golden Patricia Mine (Lac Minerals Ltd.) is located approximately 70 km west-southwest of Pickle Lake and is producing gold from a quartz-vein system. Approximately 12 km southeast of Pickle Lake, the Dona Lake Mine (Placer Dome Inc.) is producing gold from a folded, sulphide-replaced iron formation.

The last-producing base metal mine in the district—the Lyon Lake Mine (Noranda Inc.)—ceased operations in the spring of 1991. The mine had extracted zinc, copper, silver and lead ore from a massive-sulphide deposit. The ore was milled at the Mattabi Mine site where zinc, copper and lead concentrates were produced.

At the Sioux Lookout Resident Geologist's office, activities during the year were concentrated on mineral-deposit studies in the Central Uchi greenstone belt and in the Sturgeon Lake gold-mining area. A considerable amount of time was spent on building computer-based data bases, both for mineral-exploration and mineral-deposits data. The studies were done in conjunction with the Geoscience Data Centre of the Ontario Geological Survey.

MINING ACTIVITY

Mining operations were carried out in 3 locations within the Sioux Lookout Resident Geologist's District in 1991. Figures 4.2a and 4.2b give the locations of the active mines.

The Lyon Lake Mine—owned by Noranda Inc.—was the sole producing mine left in the Sturgeon Lake mining camp. Early in 1991, Noranda Inc. announced a suspension of operations effective as of May 22, 1991. In 1991, the mine produced 67 487 short tons of ore grading 7.86% Zn, 0.80% Cu, 1.24% Pb and 4.73 ounces Ag per ton (A. Scott, Mattabi Mines Ltd., personal communication, 1991). The ore was hauled by truck to the nearby Mattabi Mines Ltd. mill which produced copper, zinc and lead concentrates using flotation processes. Mattabi Mines Ltd. is owned by Noranda Inc. (60%) and Abitibi-Price Inc. (40%). Before suspension of operations, the mine and mill employed 230 workers. The work force was reduced to 25 employees, who now work on maintenance and reclamation projects (A. Scott, Mattabi Mines Ltd., personal communication, 1991).

The Golden Patricia Mine of Lac Minerals Ltd. is located near Muskegsagagen Lake, approximately 70 km southwest of Pickle Lake. The mine produces gold from a narrow quartz vein, accessed by 2 declines approximately 1 km apart. During 1991, a one-compartment shaft with manway was sunk to a depth of 1100 feet. The shaft will be used for hoisting ore and waste only; access to the workings will remain via the declines. Access to the mine site is via a winter road and by air to a landing strip located near the mine. The mine employs approximately 220 workers of which half are on site at any given time.

The mill uses conventional grinding, gravity separation and cyanidation with zinc precipitation to recover gold. In 1991, the mill operated at 350 tonnes per day and produced 46 477 ounces of gold. The head grade was 0.57 ounce Au per ton. Gold recovery was 96.5%. (J. Brisco, Golden Patricia Mine, personal communication, January, 1992).

Placer Dome Inc. operates the Dona Lake Mine, located 12 km southeast of the town of Pickle Lake. The mine is a 550 t per day underground operation accessed by a 235 m shaft. During 1991, an internal ramp was begun to access ore below the bottom of the shaft. The mill uses semi-autogenous grinding; a flotation circuit followed by cyanidation,

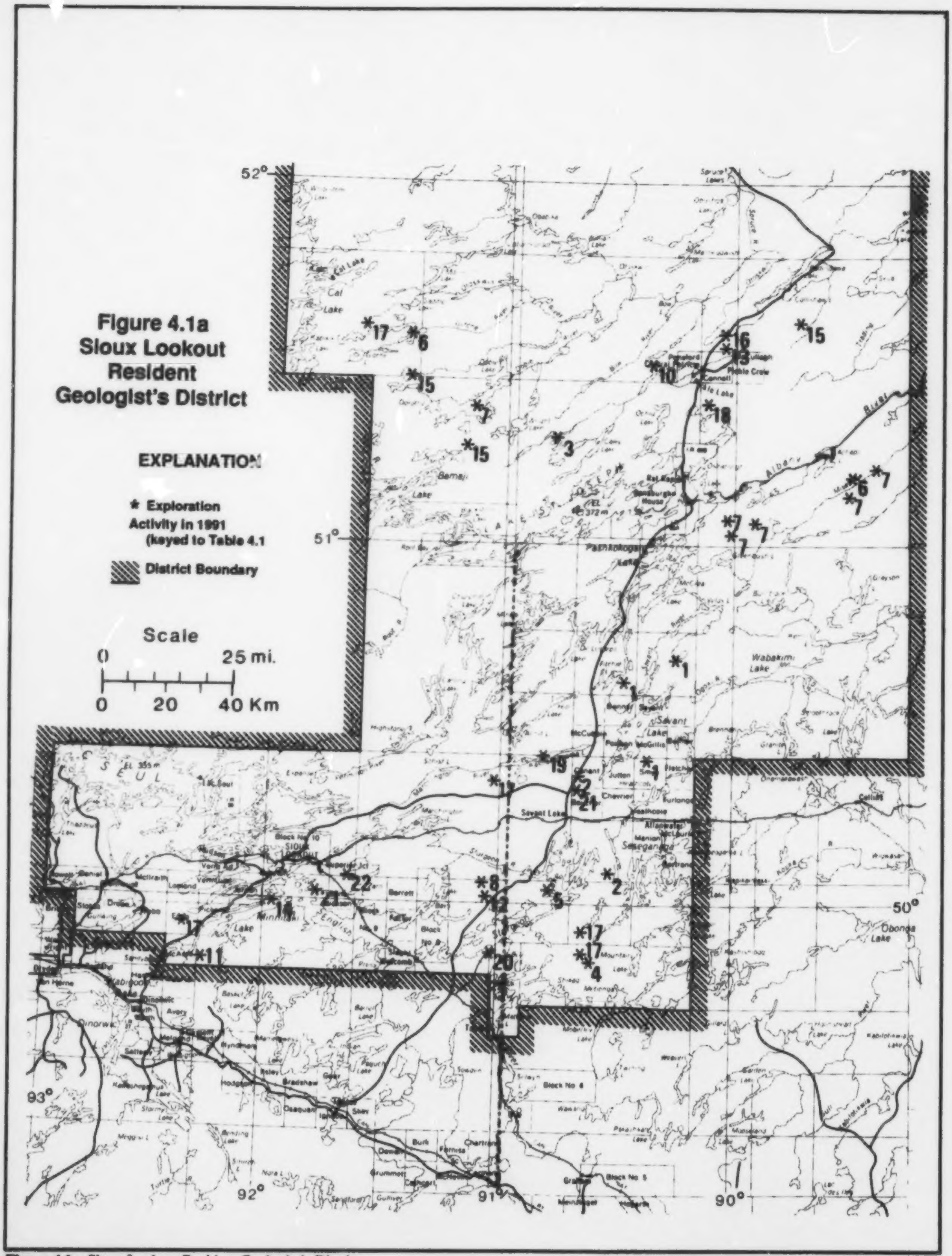


Figure 4.1a
Sioux Lookout
Resident
Geologist's District
EXPLANATION
★ Exploration Activity in 1991 (keyed to Table 4.1
District Boundary
Scale
0 25 mi.
0 20 40 Km
52°
51°
50°
93°
92°
91°
90°
Cat Lake
Bamaji Lake
Pashkokogan Lake
Savant Lake
Wabakimi Lake
Sturgeon Lake
Sioux Lookout
Minnitaki Lake
Obonga Lake
Albany River
Lac Seul

Figure 4.1a. Sioux Lookout Resident Geologist's District.

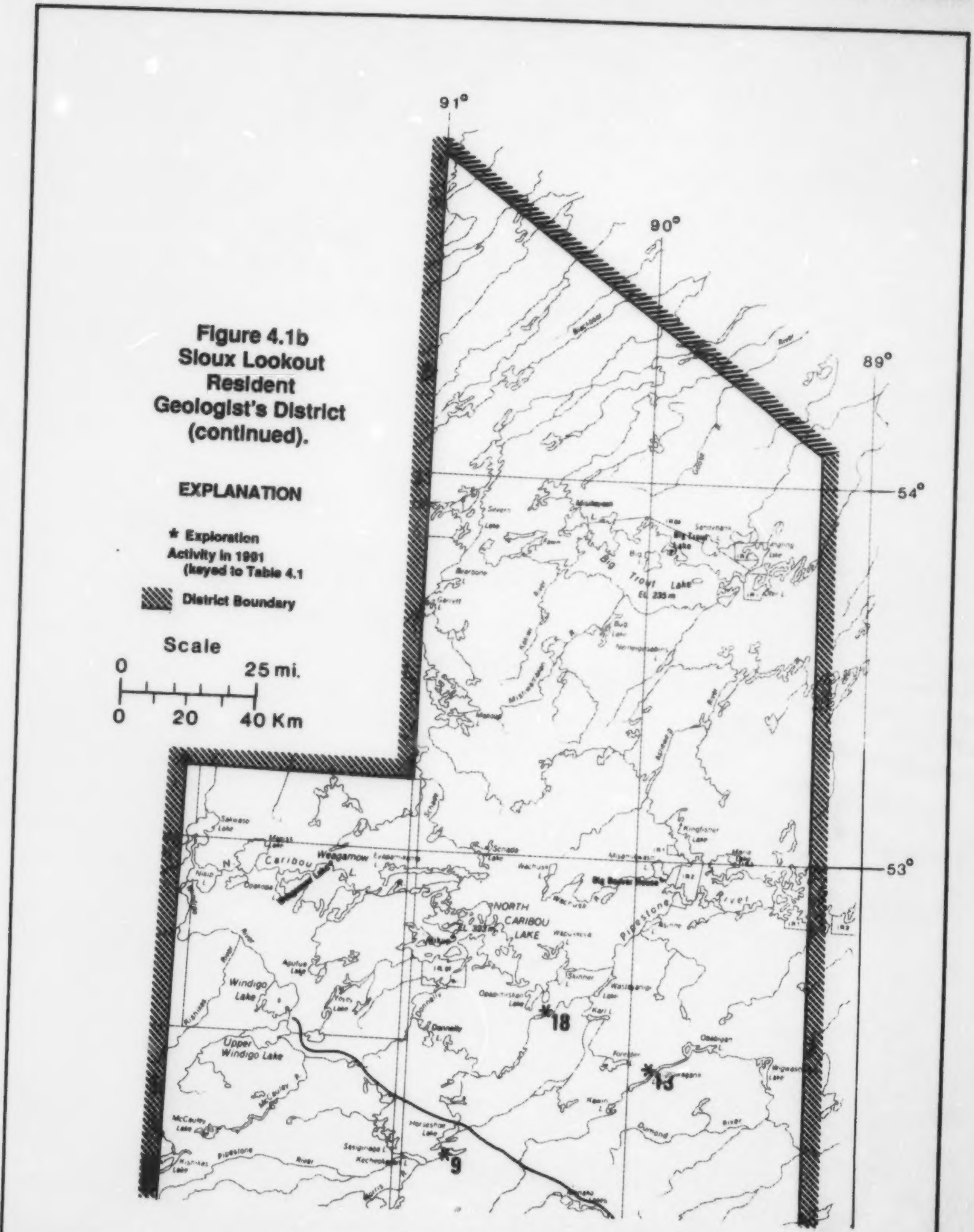

91°
90°
89°
54°
53°
Figure 4.1b
Sioux Lookout
Resident
Geologist's District
(continued).
EXPLANATION
★ Exploration
Activity in 1991
(keyed to Table 4.1
▨ District Boundary
Scale
0
25 mi.
0
20
40 Km
Big Trout Lake
Severn Lake
Sakwaso Lake
N. Caribou
Weagamow L.
NORTH CARIBOU LAKE
Pipestone River
Windigo Lake
Upper Windigo Lake
McCauley Lake
Pipestone River
Horseshoe Lake
Kingfisher Lake
Big Beaver House
Donnelly L.
Wigwasan Lake
Dumond River
18
13
9

Figure 4.1b. Sioux Lookout Resident Geologist's District (continued).

TABLE 4.1. Exploration activity during 1991.

Number on Figure 4.1a,b	Individual or Company	Activity
1	Angove, Richard	Prospecting in Smye Twp. and the Solitude Lake, Endogok Lake and Jabez Lake areas.
2	Asarco Exploration Co. of Canada Ltd.	Ground geophysical and geological surveys and diamond drilling in the Evans Lake and Conant Twp. areas.
		Ground geophysical and geological surveys in the Squaw Lake area.
3	Bazinet, E. W.	Ground magnetometer, VLF and HLEM surveys in the Duffell Lake area.
4	Benderite, Adam	Trenching and prospecting in the Dunne Lake area.
5	Best, Allan	Diamond drilling, prospecting, trenching and bulk sampling in the Squaw Lake area.
6	BHP-Utah Mines L.	Diamond drilling in the Achapi Lake area.
		Diamond drilling, air magnetometer, air electromagnetic, geological mapping, prospecting, trenching and HLEM, VLF, magnetometer and IP surveys in the McVicar Lake area and the Stoughton Lake area.
7	Bond Gold Canada Inc.	Line cutting, HLEM and magnetometer surveys and diamond drilling in the August Lake, Greenbush Lake, Heather Lake, Caron Lake and Lowry Lake areas.
		Overburden drilling in the Dobie Lake and Kawashe Lake areas.
8	Chataway, Bob	Prospecting, geological mapping, ground magnetometer and VLF-EM surveys in the Wyatt Lake area.
9	Dignard, Jean	Prospecting in the Kecheokagan Lake and Wapamisk Creek area.
10	Etruscan Enterprises Ltd.	Overburden drilling and assaying in the Ponsford Lake area.
11	Glatz, Alex	Trenching, sampling and prospecting in the Keikewabik Lake area.
12	Hollingsworth, Bill	Prospecting and diamond drilling in the Fourbay Lake and Evans Lake areas.
13	Homestake Canada L.	Diamond drilling and assaying in the Neawagank Lake area. Line cutting, geophysical surveys, geological mapping and trenching in the Tarp Lake area.
14	Kuryliw, Chester	Prospecting and geological mapping in the Pames Lake area.
15	Major General Res. L.	Diamond drilling and assaying in the Drum Lake, First Loon Lake and Meen Lake areas.
16	Minnova Inc.	Diamond drilling in the Tarp Lake area.
17	Noranda Exploration Company Ltd.	Geological mapping and prospecting in the Quest Lake area.
		Geological mapping, prospecting, gridding, soil geochemistry, trenching, ground magnetometer and IP surveys in the Dunne Lake and Quest Lake areas.
		Prospecting, HLEM and ground magnetometer surveys in the Watin Lake and Houghton Lake areas. Geological mapping, IP survey and trenching in Echo and McAree Twps.
		Line cutting, geological mapping, prospecting and soil sampling in the Lang Lake area.

TABLE 4.1. (Continued).

Number on Figure 4.1a,b	Individual or Company	Activity
18	Placer Dome Inc.	Line cutting, electromagnetic and magnetometer survey, and geological mapping in the Skinner—Zeemel lakes areas. Diamond drilling in the Dona Lake area.
19	Ramsay, Raymond G.	Ground electromagnetic survey, stripping, trenching and assay sampling in the Armit Lake area.
20	Rio Algom Exploration Inc.	Diamond drilling in the Valora Lake and Bell Lake areas.
21	Teck Explorations L.	Ground electromagnetic survey in the Evans Lake area, line cutting, ground magnetometer and electromagnetic and geological surveys in Drayton Twp.
22	Valerie Gold Res. L.	Diamond drilling in the Zam Lake area.

TABLE 4.2. Summary of claims recorded and assessment-work credit.

Year	Claims Recorded	Claims Cancelled	Claims Active	Diamond Drilling (Man Days)	Geophysical Surveys (Man Days)	Geological Surveys (Man Days)	Total (Man Days)
1980	3 485	1 391	7 068	42 633	13 524	10 800	66 957
1981	2 861	1 582	8 303	42 588	232 184	4 866	287 626
1982	842	1 766	7 737	35 486	73 486	13 900	167 289
1983	4 398	1 164	10 971	69 563.8	85 536.5	27 730	197 223.1
1984	5 009	4 074	10 625	42 425	113 830	24 941.1	205 214.64
1985	2 513	3 972	9 166	92 051	148 105	10 376	294 891
1986	7 815	3 046	13 935	109 952.4	263 118.4	29 245.4	429 481.5
1987	5 540	1 918	18 786	255 334.04	345 747.6	49 750	691 581.8
1988	2 400	2 424	18 855	179 235.2	279 066.4	66 973.3	556 154.7
1989	1 558	4 192	16 646	190 775	77 070	46 485	344 610
1990*	2 110	6 220	12 883	147 232	53 010	28 392	244 049
1991**	569	2 524	10 928	39 226.52	13 520	1 120	74 127.23

* Revised totals to year end 1990.

** Totals to end of May, 1991 only, due to change in the Mining Act.

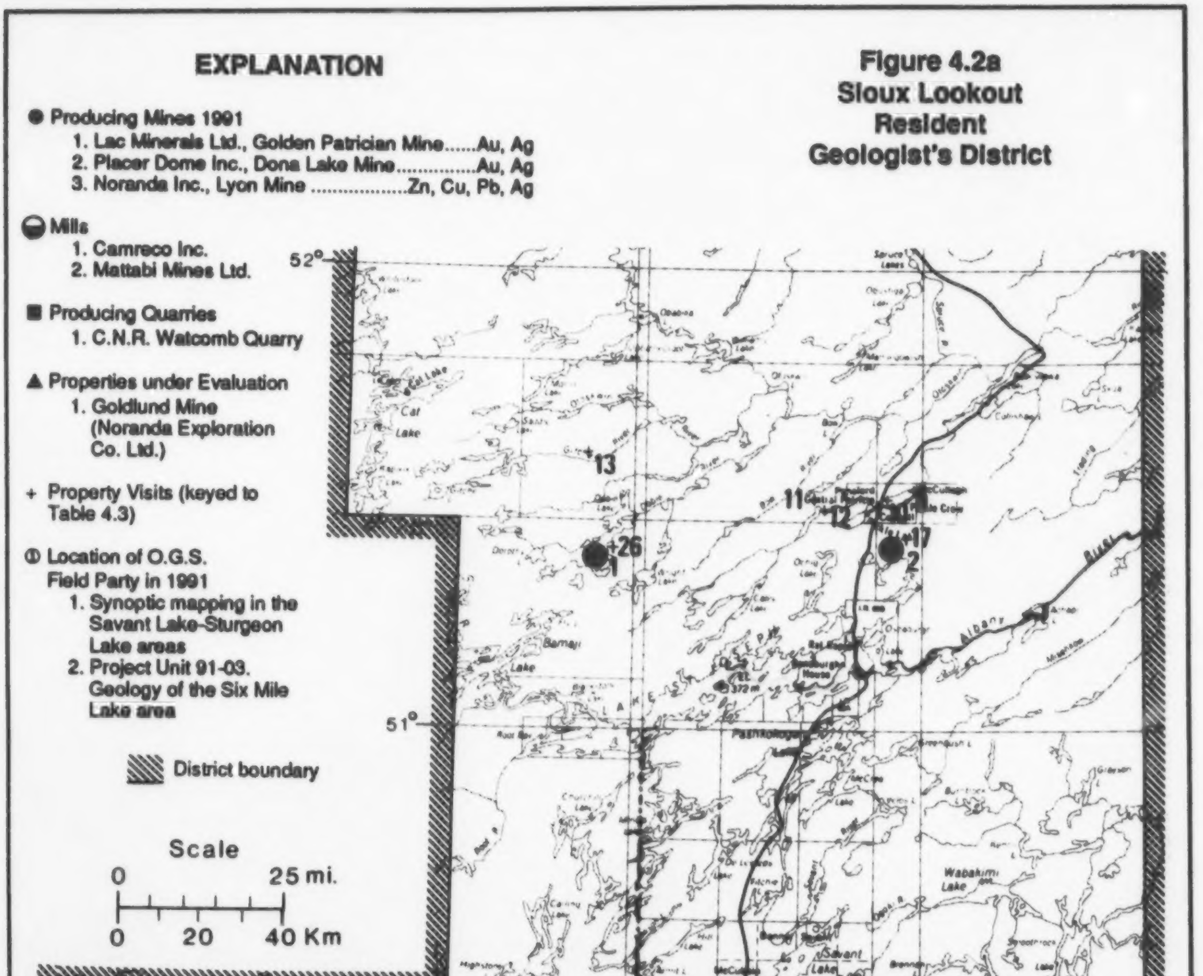
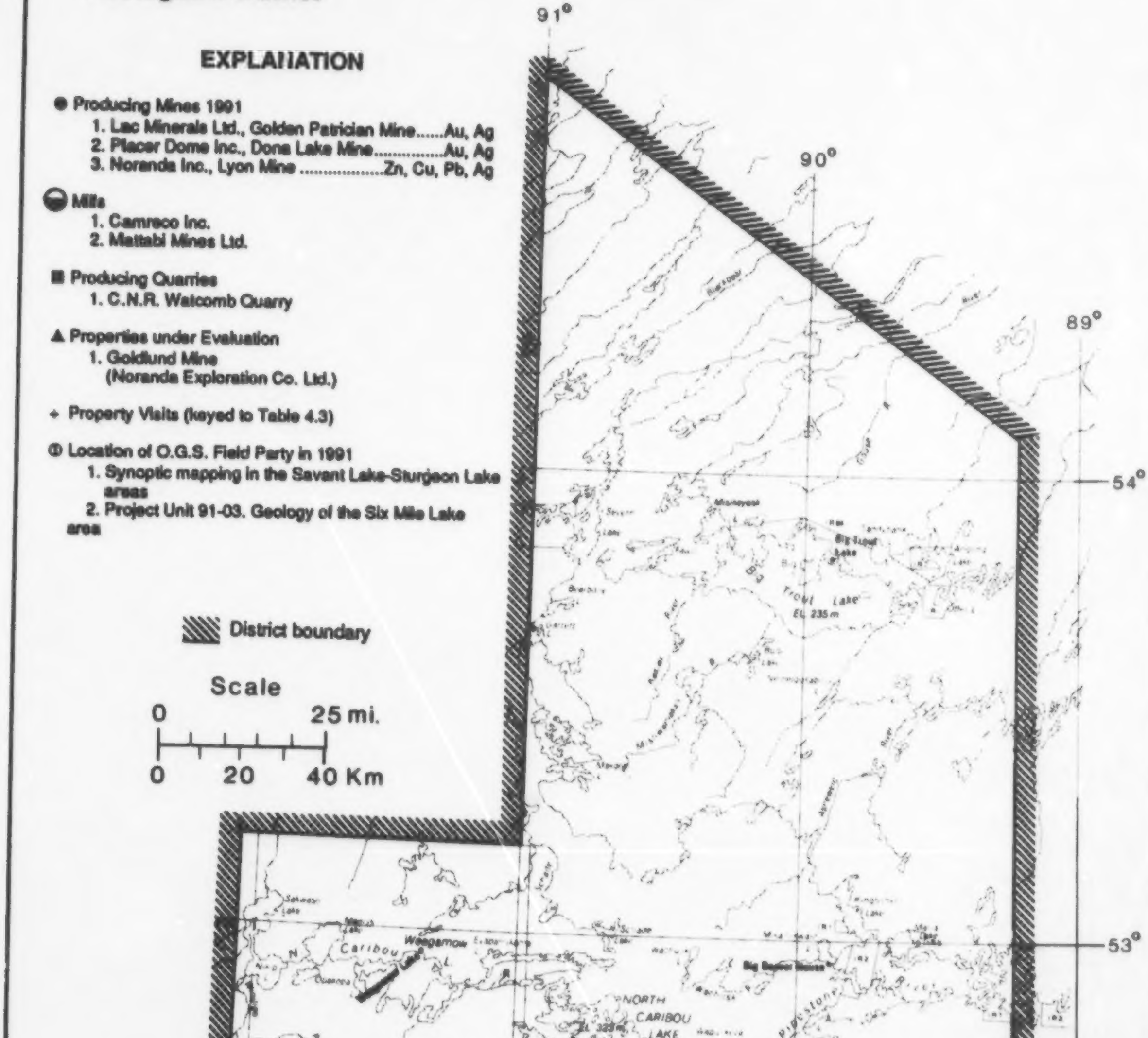

EXPLANATION
● Producing Mines 1991
1. Lac Minerals Ltd., Golden Patrician Mine......Au, Ag
2. Placer Dome Inc., Dona Lake Mine...............Au, Ag
3. Noranda Inc., Lyon Mine ....Zn, Cu, Pb, Ag
◓ Mills
1. Camreco Inc.
2. Mattabi Mines Ltd.
■ Producing Quarries
1. C.N.R. Watcomb Quarry
▲ Properties under Evaluation
1. Goldlund Mine (Noranda Exploration Co. Ltd.)
+ Property Visits (keyed to Table 4.3)
① Location of O.G.S. Field Party in 1991
1. Synoptic mapping in the Savant Lake-Sturgeon Lake areas
2. Project Unit 91-03. Geology of the Six Mile Lake area
▨ District boundary
Scale
0
25 mi.
0
20
40 Km
52°
51°
50°
93°
92°
91°
90°
Cat Lake
Bamaji Lake
Pashkokogan
Wabakimi Lake
Savant Lake
Sioux Lookout
Minnitaki
Obonga Lake
Albany River
13
26
11
12
17
18
20
32
31
3
4

Figure 4.2a
Sioux Lookout
Resident
Geologist's District

Figure 4.2b
Sioux Lookout
Resident
Geologist's District


EXPLANATION
● Producing Mines 1991
1. Lac Minerals Ltd., Golden Patrician Mine......Au, Ag
2. Placer Dome Inc., Dona Lake Mine...............Au, Ag
3. Noranda Inc., Lyon Mine ....Zn, Cu, Pb, Ag
Mills
1. Camreco Inc.
2. Mattabi Mines Ltd.
■ Producing Quarries
1. C.N.R. Walcomb Quarry
▲ Properties under Evaluation
1. Goldlund Mine
(Noranda Exploration Co. Ltd.)
+ Property Visits (keyed to Table 4.3)
① Location of O.G.S. Field Party in 1991
1. Synoptic mapping in the Savant Lake-Sturgeon Lake areas
2. Project Unit 91-03. Geology of the Six Mile Lake area
▨ District boundary
Scale
0
25 mi.
0
20
40 Km
91°
90°
89°
54°
53°
Big Trout Lake
EL 235 m
Severn
Caribou
Weagamow
Windigo Lake
Upper Windigo Lake
NORTH CARIBOU LAKE
EL 325 m
Pipestone
Big Beaver House
Pipestone River
14
15
16

with gold recovery by carbon and pulp; and electrowinning. The mine employs 100 workers. In addition, 28 contract employees are working on underground development and long hole and development drilling. A highly deformed, sulphide-replaced banded iron formation hosts the gold in the Dona Lake deposit. The deposit has proven and probable diluted reserves of 417 755 tonnes at a grade of 0.28 ounce Au per ton. In 1991, the mine produced 41 330 ounces of gold at a recovery rate of 96.6% (M. Lucko, Dona Lake Mine, personal communication, January, 1992).

ADVANCED EXPLORATION ACTIVITY

Late in 1990, Noranda Exploration Company Ltd. entered into an agreement with Camreco Inc. on the Goldlund Mine property. To earn a 50% interest in the property, Noranda must spend $5.0 million on the property over a 3 year period including $400 000 for option payments (*The Northern Miner*, December 17, 1990, p.20). Through 1991, Noranda examined the records from previous work and conducted geological mapping, an induced polarization (IP) survey and trenching on the property to assess the deposit potential of the property. At the time of writing, Noranda was about to start further trenching and a 1000 m diamond-drilling program.

Claim staking in the district is summarized in Table 4.2. The newly proclaimed Mining Act has changed the way in which mining claims may be recorded. For this reason, the claims recorded only for the first 5 months of 1991 are shown on Table 4.2. Since claims recorded after May, 1991, by the new Mining Act may vary from 1 to 16 claim units, claim staking reported henceforth will be shown in claim units. A claim unit is roughly equivalent to the claim as we knew it prior to the changes invoked by the new Mining Act in May, 1991. In 1991, 1967 claim units were staked in the Sioux Lookout Resident Geologist's District. During the year, 3244 claim units were cancelled. Active claim units at 1991 year's end totalled 11 499. For the past 4 years, an average of 2000 claim units have been staked each year.

EXPLORATION ACTIVITY

The level of exploration activity in the Sioux Lookout Resident Geologist's District continued to decline during 1991. This decline had started in the second quarter of 1989. The majority of exploration activity during 1991 took place in the Wabigoon greenstone belt which is in the southern, road-accessible part of the district. Exploration activity in the Central Uchi greenstone belt was concentrated in the Lang Lake area and within a 20 km radius of Pickle Lake. Only 2 exploration programs were undertaken in the North Caribou Lake greenstone belt. A lone prospector examined the Horseshoe Lake greenstone belt with the assistance of an Ontario Prospectors Assistance Program (OPAP) grant.

The exploration programs that were carried out in the Sioux Lookout Resident Geologist's District since December, 1990, are summarized in Table 4.1. Specific programs known by the writers to have had significant results or to have sparked wider interest are discussed by area in this report.

Sioux Lookout Area

Teck Explorations Ltd. optioned the Wright-Hargreaves property on East Bay of Minnitaki Lake from K. Bernier of Sioux Lookout in midsummer. K. Bernier had trenched a known gold showing on the property late in 1990 with the assistance of an OPAP grant. Sampling of the trenched area had expanded the area of known mineralization. K. Bernier had also traced the host deformation zone for more than 2 km along strike from the showing. In the fall of 1991, Teck Exploration Ltd. conducted a program of line cutting, geological mapping and geophysics on the optioned ground (K. Bernier, Prospector, personal communication, 1991).

At Split Lake, Valerie Gold Resources Ltd. optioned the Alcona–Split Lake mineral claims from Cream Silver Mines Ltd. (*Vancouver STOCKWATCH*, February 14, 1991). Valerie Gold Resources Ltd. conducted a short diamond-drilling program on both the No.1 and Pond Zone veins.

Southwest of Sioux Lookout near Swimit Lake, A. Glatz and A. Kozowy staked claims surrounding the Schmidt gold occurrence's patents. A. Glatz prospected these newly staked claims and conducted a trenching program; the results of these helped to extend the known strike length of the Schmidt occurrence quartz vein. The trenching exposed the quartz vein for an additional 250 feet. Samples taken by A. Glatz from the newly exposed vein assayed up to 4.36 ounces Au per ton (A. Glatz, Prospector, personal communication, 1991).

Sturgeon Lake Area

A. Benderite discovered gold mineralization associated with an iron-formation horizon near Div Lake early in 1991. Div Lake is approximately 24 km east of the Mattabi Mine site. The *Vancouver STOCKWATCH* (October 17, 1991) reported that: "Grab samples from the main showing have yielded gold values up to 0.254 ounce Au per ton. Sporadic exposures of arsenopyrite mineralization are evident over widths of 90 m and a strike length of 175 m." A. Benderite optioned the ground to Hemlo Gold Mines Inc. which staked claims along the strike of the showing for a total along-strike coverage of about 30 km. Hemlo Gold Mines Inc. then entered into a joint-venture agreement with Golden Tag Resources Ltd. on part of the ground (*Vancouver STOCKWATCH*, October 17, 1991) Later, Golden Tag Resources Ltd. optioned a portion of its interest in the ground to Trump Reserve Minerals Ltd. (*George Cross News Letter*, October 31, 1991, p.3). Noranda Exploration Company Ltd., the operator on the property for Hemlo Gold Mines Inc., completed an exploration program consisting of geological mapping, prospecting, soil geochemistry and geophysical surveys, and trenching in the fall of 1991 (W. Reid, Noranda Exploration Company Ltd., personal and written communications, 1991).

W. (Bill) Hollingsworth rediscovered gold mineralization west of Highway 599 in the Fourbay Lake area. The discovery area is approximately 2 km southeast of Rome Lake. The mineralization occurs within blue quartz veins in mafic metavolcanics. Mr. Hollingsworth conducted prospecting, stripping and drilling on the discovery with the assistance of an OPAP grant (W. Hollingsworth, Prospector, personal communication, 1991).

Savant Lake Area

The release of the Savant Lake–Sturgeon Lake airborne geophysical survey, November 26, 1990, resulted in the claim staking of several anomalies along the Marchington Lake Road and Highway 599 by Noranda Exploration Company Ltd. and Asarco Exploration Co. of Canada Ltd. Both companies did ground follow-up work on the anomalies. Asarco Exploration Co. of Canada Ltd. completed a short diamond-drilling program in the fall of 1991 and acquired additional ground subsequent to the diamond-drilling program.

R. Ramsay and G. Hogg continued to work on their Kashaweogama Lake property. The exploration program consisted of geological mapping, a magnetometer survey, trenching and sampling. Several samples from various locations on the property were analyzed and found to contain up to 1000 ppb Au (G. Hogg, personal communication, 1991).

About 1 km south of the Hadley occurrence, W. Hollingsworth intersected sphalerite in altered metavolcanics in a series of short X-ray diamond-drill holes (W. Hollingsworth, Prospector, personal communication, 1991).

Bamaji Lake–Fry Lake Area

Major General Resources Ltd. encountered a high-grade gold intersection assaying 0.70 ounce Au per ton over 0.5 m at the Linjog prospect on their McVean Lake claim block (McVean Lake is located approximately 22 km south of the Golden Patricia Mine). The gold mineralization is hosted by a shear zone which cuts a thick iron-formation horizon. The iron formation intersected in the drill hole is anomalous in gold over a core length of 80 m. Subsequent to the diamond-drilling program, Major General Resources Ltd. acquired additional claims to form a contiguous claim block stretching over 20 km (*George Cross News Letter*, March 20, 1991, p.2).

Lang Lake–McVicar Lake Area

The Lang Lake–McVicar Lake area experienced heavy claim-staking activity during the year by Noranda Exploration Company Ltd., BHP- Utah Mines Ltd. and Trev Corp.

Noranda Exploration Company Ltd. acquired the Lang Lake copper occurrence and conducted an exploration program consisting of line cutting, geological mapping, prospecting and soil sampling. Later in 1991, Noranda acquired, by claim staking, the Saddle Lake Cu-Zn prospect (W. Reid, Noranda Exploration Co. Ltd., written and personal communications, 1991).

Early in 1991, BHP-Utah Mines Ltd. conducted a diamond-drilling program on their McVicar Lake property. Several diamond-drill holes intersected a new zone of gold mineralization along strike of the Altered Zone Gold occurrence on the same deformation zone (File nos. 52 O/11SW-0058 and 52 O/11SW-0059, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). This encouragement led to the acquisition of about 200 claims and the commissioning of an airborne geophysical survey. BHP-Utah Mines Ltd. conducted an exploration program consisting of geological mapping, prospecting, trenching and ground geophysics. This worked was assisted by funds from the Ontario Mineral Incentives Program (OMIP) (R. Thomas, BHP-Utah Mines Ltd., written communication, 1991; R. Bonner, BHP-Utah Mines Ltd., personal communication, 1991).

Pickle Lake Area

In January and February of 1991, Minnova Inc. and Consolidated Gold Hawk Resources Inc. conducted a 7 hole diamond-drilling program on the Tarp Lake Project, approximately 18 km north of Pickle Lake. The objective of the program was to test the extent of a zone of gold mineralization in the Tarp Lake deformation zone. The drilling defined the limits of the target gold-bearing zone, with 1 drill hole intersecting economically significant mineralization (0.103 ounce Au per ton over 16.5 feet) and 3 drill holes intersecting mineralization anomalous in gold. Three of the diamond-drill holes intersected a new zone of gold mineralization 200 feet west of the previously known gold-bearing zone. Minnova Inc. plans to follow up with an IP survey and additional diamond drilling (P. Lewis, Minnova Inc., written communication, 1991).

Homestake Canada Ltd. optioned the Pickle Pat (a.k.a. Metcalfe, Dora) property 10 km northeast of Pickle Lake from the Hughes Lang Corporation. Homestake Canada Ltd. conducted an exploration program consisting of line cutting, geological mapping, geophysical surveys, trenching and sampling on the property in the fall of 1991.

ONTARIO GOVERNMENT INCENTIVES PROGRAMS

The Ontario Government assists mineral exploration in the province through the Ontario Prospectors Assistance Program (OPAP) and the Ontario Mineral Incentives Program (OMIP). In 1991, OPAP assisted 11 prospectors in the Sioux Lookout Resident Geologist's District with grants totalling $109 850. OMIP aided 7 mineral-exploration companies working in the Sioux Lookout Resident Geologist's District with funds totalling $409 514.

MINERAL DEPOSIT INVENTORY AND GEOLOGICAL EXPLORATION DATABASE

During part of 1991, H. Waller was employed as a Computer-Aided Design Technician to convert existing paper data bases into electronic media. The Geological Data Inventory Folios (GDIFs) produced in the past contain maps of the location of exploration sites, mineral occurrences, drill-hole locations and mine locations. This data was entered onto 1:250 000 scale digital base maps (produced by Energy, Mines and Resources Canada) using AutoCAD®. The eventual product will be plotted at a scale of 1:50 000. In time, it is hoped that all exploration data for the Sioux Lookout Resident Geologist's District will be entered in this manner. The Thematic Mapper/Geographical Information System program (TM/GIS) will link the AutoCAD® dxf files with the Geological Exploration Database (GED). A powerful, graphically accessed data base, capable of Structured Query Language (SQL) inquiries will be the result of this arrangement. This program was done in co-operation with the Geoscience Data Centre of the Ontario Geological Survey.

In 1990 and 1991, a contractor was hired to input data into an Ontario Mineral Deposit Inventory (MDI). The data, which will form part of the Geological Exploration Database (GED), was researched in the Resident Geologist's office, Sioux Lookout.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

The Ontario Geological Survey (OGS) fielded 2 summer-time-mapping parties in the Patricia Mining Division in 1991. H.R. Williams and S.M. Nacha, Precambrian Geology Section, conducted a structural and stratigraphic examination of the northern portion of the Sturgeon Lake area. This is a continuation of the program that was carried out by M. Sanborn-Barrie between 1989 and 1990. A preliminary report of the findings is included in the Ontario Geological Survey publication Miscellaneous Paper 157 (Williams and Nacha 1991).

A mapping program was conducted by D.J. Robinson and P.J. MacLean of Robinson Exploration Services Ltd. in association with A.C.A. Howe International Ltd. in the Six Mile Lake area within the greater Savant–Sturgeon lakes area. This map was prepared at a scale of 1:15 840 and covered an area which includes several known gold occurrences. This work outlined an east-striking series of intercalated mafic and felsic metavolcanic assemblages which appear to be, at least in part, equivalent to the mafic-felsic assemblage on the North Arm of Sturgeon Lake. This work is reported in Ontario Geological Survey publication Miscellaneous Paper 157 (Robinson and MacLean 1991).

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

Classified staff in the Resident Geologist's office include D.A. Janes, Resident Geologist; G.W. Seim, Geologist; and M.O. Roy, Geological Secretary. Contract staff during 1991 included H.T. Waller, Summer Assistant and Computer-Aided Drafting Technician; E.A. Young, Data Base Programmer; and M.P. Kamps, Temporary Geological Secretary.

D.A. Janes continued an evaluation of the mineral deposits in the Wabigoon Subprovince portion of the district. The producing mines within the district were visited at least once. The 2 Ontario Geological Survey field parties were visited several times during the field season. The Resident Geologist served on the Information Technology Committee and the Information Services Branch Re-organization Committee.

G.W. Seim continued the examination of mineral occurrences in the Central Uchi greenstone belt and made a 1 week examination of mineral occurrences in the Horseshoe Lake greenstone belt. A structural study of gold occurrences on the Pickle Crow gold-mine and Central Patricia gold-mine properties was begun in the fall of 1991. The Staff Geologist guided 13 field trips for industry and government personnel to the south Sturgeon Lake, Savant Lake and Pickle Crow areas.

The staff of the Resident Geologist's office and the Patricia Mining Recorder's office conducted an 18 hour basic-prospecting course. This course was held in Savant Lake during the winter months. The staff of the Resident Geologist's office conducted 32 property visits during the year, concentrated in the Sturgeon Lake and Pickle Lake areas—refer to Table 4.3 for an itemization of these property visits and consult Figure 4.2a and 4.2b for locations. In addition, the Resident Geologist and the Staff Geologist contributed technical poster displays and talks at the Ontario Geoscience and Northwest Geoscience symposia.

During 1991, 375 consultations with industry personnel took place in the office and an additional 996 telephone requests were received and answered. The number of visitors to the office is down from 1990, but the number of telephone consultations is considerably higher than the total for 1990.

M.O. Roy and H.T. Waller continued to up-grade the office exploration and mineral-deposits files. H.T. Waller assisted on the property visits and digitized exploration data for use in internal data base needs. H.T. Waller's work is discussed further in the Mineral Deposits Inventory and Geological Exploration Database section of this report.

TABLE 4.3. List of property examinations during 1991.

1. Wright-Hargreaves occurrence
2. Pond Zone Occurrence, Split Lake
3. Redpine Bay area, Minnitaki Mining Syndicate
4. Schmidt occurrences
5. Twinflower Bay area, Noramco property
6. Mattabi Mines
7. Hadley occurrence
8. Sabin occurrence
9. Pickle Crow Mine property
10. Central Patricia property
11. Thierry Mine property
12. Central Patricia occurrence, Kapkichi Lake
13. C.L. Boland occurrence
14. Shear Zone occurrence, Horseshoe Lake
15. Sanderson occurrence, Horseshoe Lake
16. Rust Seep Zone, Horseshoe Lake
17. Dona Lake Mine
18. Near Hadley occurrence, Savant Lake
19. United States occurrence, King Bay
20. Armstrong-Best occurrence, King Bay
21. Rainbow occurrence, Sturgeon Lake
22. Oz Island occurrence, Sturgeon Lake
23. Sturgeon Lake Mine
24. Shores Bay occurrence, King Bay
25. St. Anthony Mine, Sturgeon Lake
26. Golden Patricia Mine, Muskegsagagen Lake
27. Coveney occurrence, Sturgeon Lake
28. Copper Lake occurrence, Sturgeon Lake
29. Rickaby Mines, Sturgeon Lake
30. Goldlund Mine, Echo Township
31. Fourbay Lake occurrence, Sturgeon Lake
32. Mac-Read occurrence

PROPERTY EXAMINATIONS

Mineral Occurrences of the Horseshoe Lake Greenstone Belt

LOCATION AND ACCESS

The Horseshoe Lake greenstone belt is located approximately 100 km north-northwest of Pickle Lake, Ontario. Highway 808, an all-weather gravel road, extends north from Pickle Lake and passes by the eastern end of the greenstone belt. Boats launched where the highway crosses the Pipestone River may be used to travel upstream to Horseshoe Lake, located in the centre of the greenstone belt. Horseshoe Lake and Kecheokagan Lake are both suitable for landing on with float-equipped aircraft.

MINERAL EXPLORATION HISTORY

Jensen (1989) estimated that prospecting in the Horseshoe Lake greenstone belt began in the early 1920s. The first recorded exploration of the greenstone belt was by Rio Tinto Exploration Ltd. in 1965. They conducted an exploration program that consisted of ground magnetic and electromagnetic surveys followed by a diamond-drilling program. In the 1970s, Great Plains Development Company of Canada, Ltd. and Dome Exploration (Canada) Ltd. conducted exploration programs in the belt. Great Plains Development Company of Canada, Ltd. focussed on base metals and conducted airborne and ground, magnetic and electromagnetic surveys and diamond drilling. Dome Exploration (Canada) Ltd. focussed on gold and conducted ground geophysical surveys, soil-geochemistry surveys, trenching and diamond drilling on 2 properties.

Throughout the 1980s, 6 different companies explored for gold and base metals in the Horseshoe Lake greenstone belt. The exploration work consisted of both airborne and ground geophysical surveys, soil-geochemistry surveys, geological mapping, trenching and diamond drilling.

No work has been recorded in the Horseshoe Lake area since 1988, and all claims, except for a leased 12 claim block, have lapsed. W. Hollingsworth, a prospector working with the assistance of an OPAP grant, prospected in the Horseshoe Lake area during the summer of 1991.

GENERAL GEOLOGY

Jensen (1989) mapped the geology of the Horseshoe Lake greenstone belt for the Ontario Geological Survey at a scale of 1:15 840. Prior to mapping by Jensen, Carruthers (1961), working for the Geological Survey of Canada, and Sage and Breaks (1982), working for the Ontario Geological Survey, had mapped the greenstone belt at reconnaissance scales.

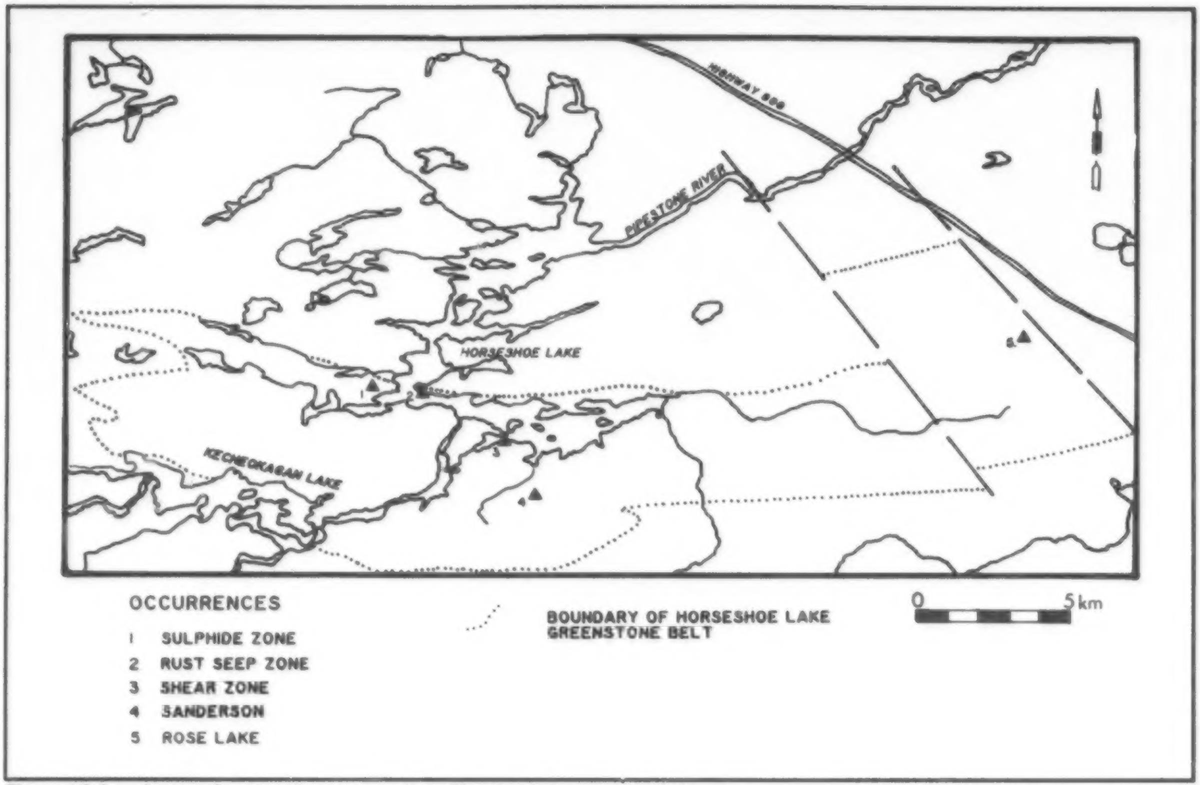


Figure 4.3. Location map for mineral occurrences in the Horseshoe Lake greenstone belt.

The Horseshoe Lake greenstone belt is located at the southern boundary of the Sachigo Subprovince. The belt and the rocks within are generally east trending.

Four major, east-trending faults divide the greenstone belt into 4 structurally and lithologically distinct geological domains (Jensen 1989). The Central Domain accounts for the majority of rocks that make up the Horseshoe Lake greenstone belt. The Central Domain is comprised of middle- to upper-greenschist grade tholeiitic basalts interlayered with quartz-rich clastic metasediments and chemical metasediments. The principal structure of the Central Domain is an easterly plunging, overturned anticline. East- and/or northeast-trending faults crosscut the rocks of the Central Domain in the hinge zone of the anticline. Rock samples taken along these faults are anomalous in gold (Jensen 1989).

The Calc-alkalic Domain extends along the northern shore of Horseshoe Lake and along Wapamisk Creek. Calc-alkaline, mafic to felsic volcanics interlayered with iron formation comprise the succession of rocks contained within the Calc-alkalic Domain. This succession is less than 1 km in thickness in the west and thickens to over 2 km to the east. The metamorphic grade of the Calc-alkalic Domain is lower-greenschist facies (Jensen 1989).

The Northern and Southern domains are of much less areal extent than the Central and Calc-alkalic domains. The Northern Domain, found along the north-central margin of the Horseshoe Lake greenstone belt, comprises quartz-rich sedimentary rocks with subordinate interlayers of tholeiitic basalts—all at middle- to upper-greenschist grade metamorphism. The Southern Domain comprises lower-amphibolite grade arkosic sedimentary rocks (Jensen 1989).

MINERAL OCCURRENCES

A search of the assessment files in the Sioux Lookout Resident Geologist's office and through other relevant sources revealed that 3 gold occurrences and 1 base metal occurrence were discovered by past exploration in the Horseshoe Lake greenstone belt (G.W. Seim has used OGS standards to define a mineral occurrence). The gold occurrences are all within 2 km of the shores of Horseshoe Lake. The base metal occurrence (a drill-hole intersection) is located in the eastern part of the greenstone belt, north of Wapamisk Creek near Highway 808 (Figure 4.3). During the last week of August, 1991, the Staff Geologist made a trip to Horseshoe Lake to examine the surface gold mineralization and the geology in the greenstone belt.

The Sulphide Zone Gold Occurrence

Rio Tinto Canadian Exploration Ltd. discovered the Sulphide Zone gold occurrence in 1961 (*see* Figure 4.3). The occurrence is located within the Calc-alkalic Domain. Sage

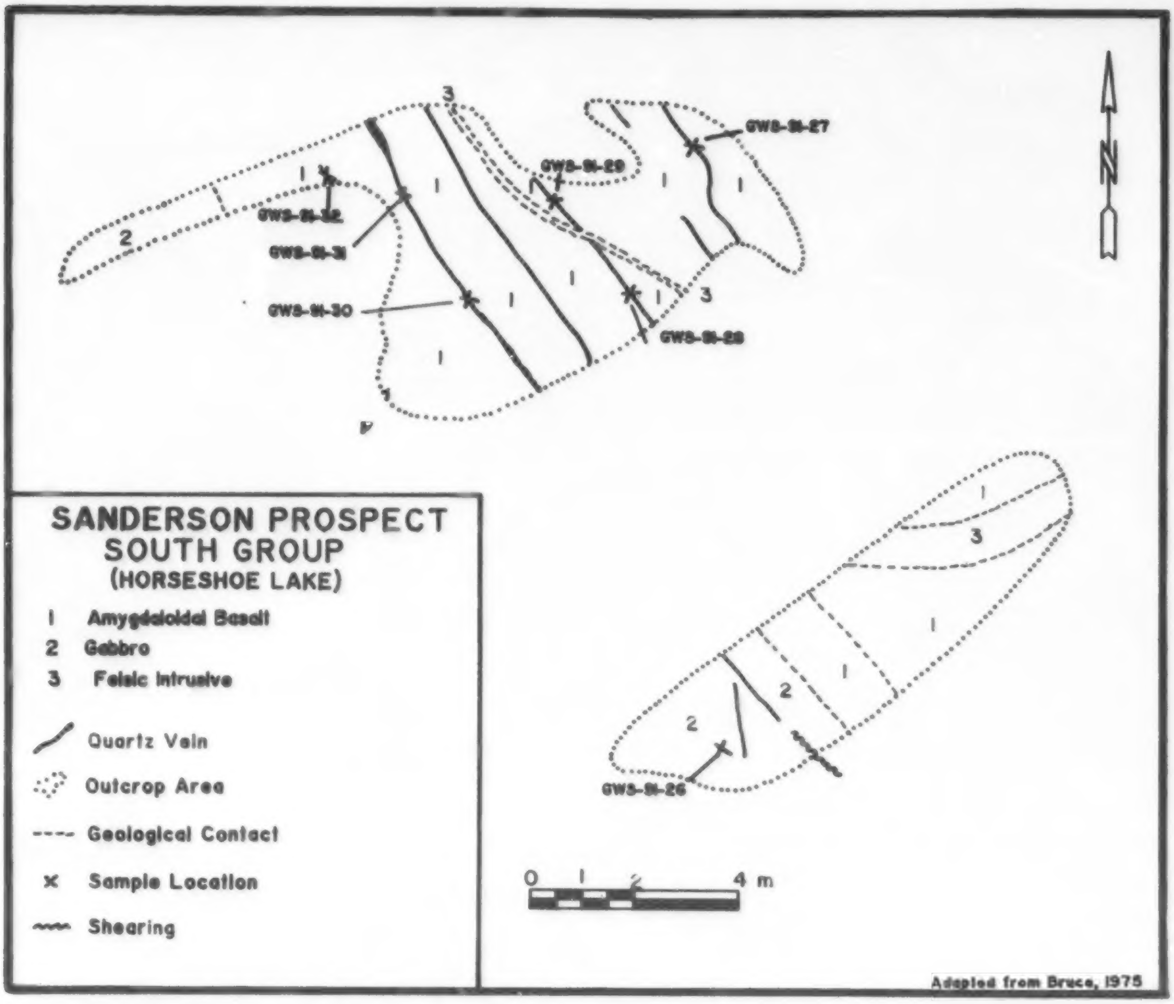

SANDERSON PROSPECT
SOUTH GROUP
(HORSESHOE LAKE)
1 Amygdaloidal Basalt
2 Gabbro
3 Felsic Intrusive
Quartz Vein
Outcrop Area
Geological Contact
× Sample Location
Shearing
N
0 1 2 4 m
GWS-91-26
GWS-91-27
GWS-91-28
GWS-91-29
GWS-91-30
GWS-91-31
GWS-91-32
1
2
3
Adapted from Bruce, 1975

Figure 4.4. Geology of the Sanderson prospect, south group, Horseshoe Lake.

and Breaks (1982) describe Rio Tinto Canadian Exploration Ltd.'s work on this occurrence as follows:

> On the Sulphide Zone Group, a series of concordant massive sulphide horizons have been indicated by ground magnetic and electromagnetic surveys by both Rio Tinto Canadian Exploration Limited (unpublished Company report) and Great Plains Development Company of Canada Limited (Assessment Files Research Office, Ontario Geological Survey, Toronto). One diamond drill hole of Rio Tinto Canadian Exploration Limited intersected one massive sulphide horizon having a cumulative thickness of 7.6 m. Strike lengths of strong conductive horizons vary up to 300 m (unpublished company report). This sulphide zone occurs within schistose chloritic mafic metavolcanics associated with local intercalations of dacitic lapilli tuff (sample AH7-50, Appendix A, Chart C, back pocket). Best core assays by Rio Tinto Canadian Exploration Limited, indicated 0.12 percent copper over 0.30 m, 0.05 ounces gold per ton over 0.94 m, and 0.06 ounces silver per ton over 0.43 m (unpublished company report). On site of the diamond drill hole a pronounced reddish brown gossan development is apparent.

Several other exploration companies examined the area around this gold occurrence without encountering economically significant mineralization. The Staff Geologist did not examine this occurrence.

Shear Zone Occurrence

Rio Tinto Canadian Exploration Ltd. discovered this gold occurrence in 1961. The original discovery is located on a point of land situated along the east side of the mouth of the east channel of the Pipestone River where the river enters Horseshoe Lake (*see* Figure 4.3). An unpublished company report indicates that an assay of 0.20 ounce gold per ton over 0.3 m was reported from a sample collected from a 2.9 m wide shear zone (Sage and Breaks 1982). In 1965, Rio Tinto Canadian Exploration Ltd. drilled 4 diamond-drill holes totalling 365 m on the showing without intersecting significant mineralization. In the mid-1970s, Dome Exploration (Canada) Ltd. staked the showing and completed a program of ground geophysics and 15 diamond-drill holes (1958 m) on a 12 claim group. One drill hole, collared inland about 200 m southeast of the original showing, intersected 0.07 ounce Au ton over 2.0 m and 0.03 ounce Au per ton over 2.3

m. There is no record of work on the showing since 1976 and the 12 claims were taken to lease by Dome Exploration (Canada) Ltd. in 1986.

Sage and Breaks (1982), during the Ontario Geological Survey's Operation Pickle Lake in 1972, made an examination of the Shear Zone gold occurrence. Two shear zones are described in their report. The first is located on the west side of the mouth of the Pipestone River's east channel and is described as follows:

> On the Shear Zone Group, disseminated pyrite (5 to 10 percent) is confined to a zone 1.2 m in width composed of a series of *en echelon* shears. The individual shears, which strike N20°E are usually less than 5 mm in width. The host rock consists of massive, medium-grained gabbro. A grab sample taken by the field party of the mineralization registered 0.10 ounce of gold per ton, and traces of silver (assays by Geoscience Laboratories, Ontario Geological Survey). A qualitative spectrographic analysis indicated the presence of significant quantities of arsenic.

The second shear zone corresponds to the Rio Tinto discovery (the Shear Zone occurrence) and Sage and Breaks (1982) describe it as follows:

> On claim PA 35425 on the southern shoreline of Horseshoe Lake a rusty pyritic shear zone trending N55°E had been previously exposed by the stripping of Rio Tinto Canadian Exploration Limited.
>
> On the Shear Zone Group, mineralization appears largely confined to narrow quartz veinlets emplaced within shear zones as exemplified by the southeastern showing [*see* Figure 5 of Sage and Breaks (1982)]. Pyrite, the only sulphide observed, is rather scarce (usually less than 5 percent) and apparently largely converted to a limonitic gossan. A few fractures normal to these veinlets contain sparse pyrite. A 1.5 m wide quartz-feldspar porphyry dike parallels this mineralized shear zone. A grab sample taken by the present survey from this occurrence recorded 0.08 ounce gold per ton and traces of silver (assays by Geoscience Laboratories, Ontario Geological Survey).

While at Horseshoe Lake, G.W. Seim, the Staff Geologist, examined the site of the Rio Tinto discovery. Three subparallel shear zones strike 040° to 050° and dip 60° to 70°NW. The host rock to the shear zones is a massive, medium-grained basalt which locally contains sparse blue-quartz phenocrysts. The central shear zone is probably the one which Rio Tinto Canadian Exploration Ltd. and Sage and Breaks (1982) had sampled; it varies from 1.5 to 2 m in width. This shear zone contains up to 1% pyrite in stringers and less than 1% finely disseminated, interstitial pyrrhotite and, possibly, chalcopyrite. A porphyritic, fine-grained basalt dike cuts the central shear zone and strikes 000° dipping 78°E. The 2 outside shear zones are in the order of 0.5 m wide each. The east shear zone contains 1% to 3% pyrite. A 1.5 m wide quartz-perthite porphyry dike parallels the west contact of the west shear zone. Occasional quartz veinlets are found within the shear zones, but there is no apparent silicification or other form of alteration.

The Staff Geologist took 2 grab samples from the Shear Zone occurrence. The sample from the central shear zone assayed 0.031 ounce Au per ton, and a sample from the east shear zone returned 0.004 ounce Au per ton (Temiskaming Testing Laboratories, Cobalt).

TABLE 4.4. Assay results for the Sanderson Occurrence.

Sample #	Description	Au (oz./ton)
GWS-91-26	grab sample of a gossan-stained, medium-grained gabbro	nil
GWS-91-27	15 cm chip of quartz-sulphide vein	1.147
GWS-91-28	8 cm chip of quartz-sulphide vein	0.006
GWS-91-29	5 cm chip of quartz-sulphide vein	nil
GWS-91-30	5 cm chip of quartz-sulphide vein	0.734
GWS-91-31	5 cm chip of quartz-sulphide vein	0.177
GWS-91-32	5 cm chip of quartz-sulphide vein	0.006

Note: In description, a "5 cm chip" refers to the distance along the vein over which the chip sampling was conducted.

The Sanderson Occurrence

A.M. Sanderson, Prospector, discovered gold mineralization approximately 1.8 km south of Horseshoe Lake in 1974 while working for Dome Exploration (Canada) Ltd. (*see* Figure 4.3). He staked a group of 4 claims centred on the discovery. In 1975, Dome Exploration (Canada) Ltd. carried out a program of line cutting, a magnetometer survey, a detailed soil-geochemistry survey and geological mapping on the claims. A 2 hole diamond-drilling program totalling 183 m followed in 1976.

The area around the gold occurrence is swampy with sparse outcrop. Dome Exploration (Canada) Ltd.'s geological mapping and the Staff Geologist's observations suggest that the area is underlain by fine- to coarse-grained basaltic flows, and quartz-rich metasediments of Jensen's (1989) Central Domain. Quartz-feldspar (perthite) porphyry dikes and andesitic dikes cut the Central Domain rocks. The dikes usually trend northwest, but 1 quartz-feldspar porphyry dike was observed to strike east. Dome Exploration (Canada) Ltd.'s geological mapping located a unit of granodiorite approximately 400 m south of the discovery area (File no. 53 B/02NW-0014-A1, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). The discovery is located on a low ridge on the south side of a 400 m wide black-spruce swamp. The gold mineralization occurs in narrow quartz-sulphide veins (less than 15 cm wide) that strike 330° to 340° and dip 80°E, (Figure 4.4). The veins are hosted by a fine-grained crystalline amygdaloidal basalt. A foliation in the basalt strikes 100°. The quartz veins occur in shear zones up to 30 cm thick. A 5 cm wide quartz-feldspar porphyry dike cuts the basalt, a shear zone and a quartz-sulphide vein. The dike

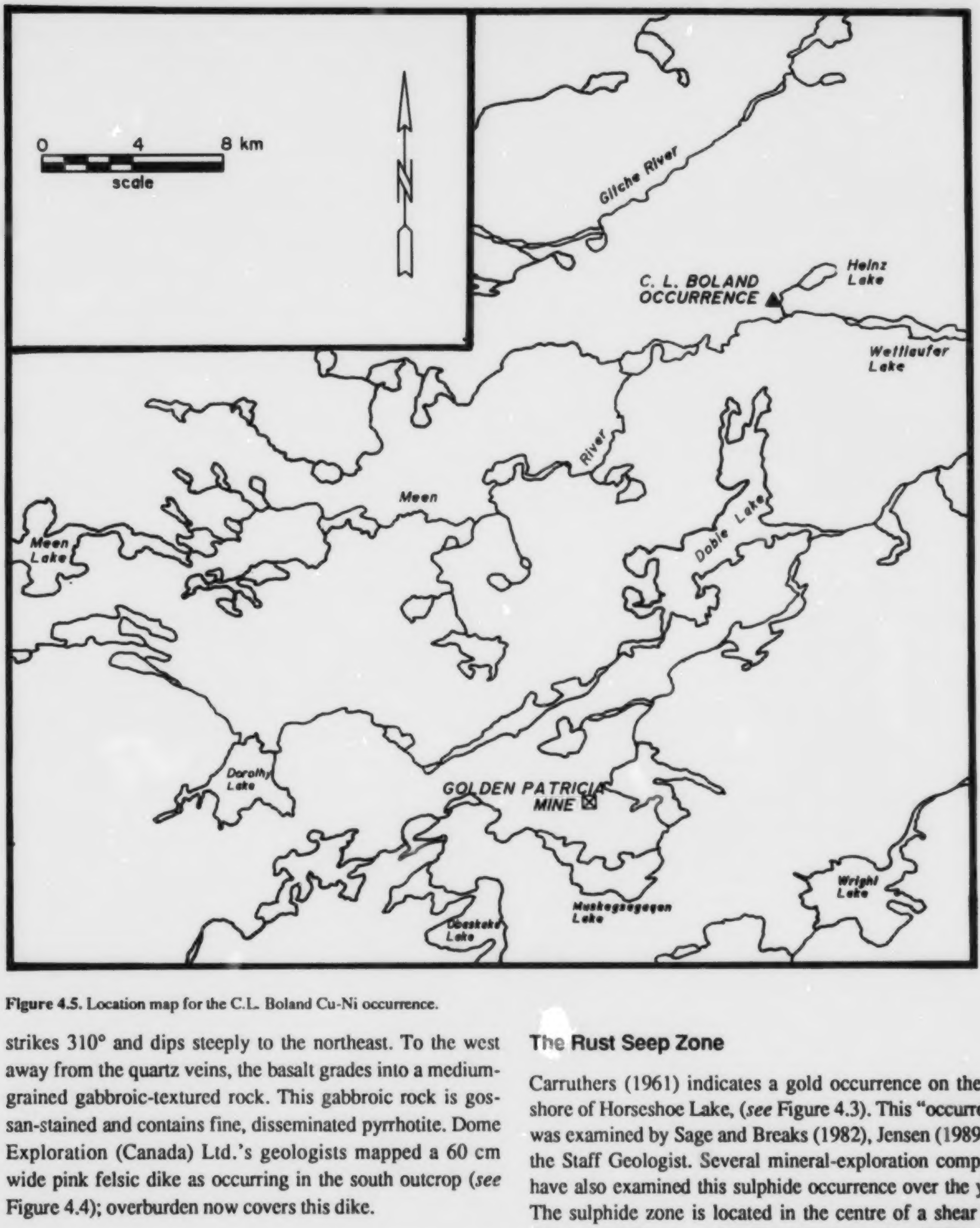

0
4
8 km
scale
N
Gilche River
C. L. BOLAND OCCURRENCE
Heinz Lake
Wetlaufer Lake
River
Meen
Meen Lake
Doble Lake
Dorothy Lake
GOLDEN PATRICIA MINE
Wright Lake
Muskegsagagen Lake
Obaskaka Lake

Figure 4.5. Location map for the C.L. Boland Cu-Ni occurrence.

strikes 310° and dips steeply to the northeast. To the west away from the quartz veins, the basalt grades into a medium-grained gabbroic-textured rock. This gabbroic rock is gossan-stained and contains fine, disseminated pyrrhotite. Dome Exploration (Canada) Ltd.'s geologists mapped a 60 cm wide pink felsic dike as occurring in the south outcrop (*see* Figure 4.4); overburden now covers this dike.

The Staff Geologist took 7 combined grab and chip samples from this occurrence. The location of these samples are indicated on Figure 4.4; Temiskaming Testing Laboratories fire-assayed the samples. The assay results are given in Table 4.4.

The Rust Seep Zone

Carruthers (1961) indicates a gold occurrence on the east shore of Horseshoe Lake, (*see* Figure 4.3). This "occurrence" was examined by Sage and Breaks (1982), Jensen (1989) and the Staff Geologist. Several mineral-exploration companies have also examined this sulphide occurrence over the years. The sulphide zone is located in the centre of a shear zone that is over 30 m in width. The shearing strikes 075° to 080° and dips 80° to 90°N. The host rock to the sulphide body is a variably sheared, medium-grained basalt that exhibits deformed-pillow textures. The basalt is locally schistose, chloritic and carbonatized. A 3 m wide, strike-parallel quartz-feldspar porphyry dike intrudes the basalt 5 to 6 m south of the sulphide zone. The sulphide zone is up to 3 m in width, and the only sulphide present is pyrite. Sage and Breaks (1982) describe the Rust Seep zone as follows:

> The mineralization occurs in a rusty, intensely sheared zone which approximately parallels the shoreline of Horseshoe Lake. Small ovoid areas up to 60 cm in length consist largely of granular pyrite with ancillary fragments of chloritic material. Local impregnations of quartz are fractured and engulfed by pyrite. No other sulphide mineral was observed. Two grab samples of the pyritic material taken by the field party recorded trace to 0.02 ounce gold per ton, traces of silver (assay by Geoscience Laboratories), and no significant quantities of any other economically important metals as revealed by emission spectroscopy.

The Staff Geologist took 4 grab samples from the Rust Seep zone. Assays by Temiskaming Testing Laboratories returned values of nil or trace Au.

The Rose Lake Copper Occurrence

Great Plains Development Company of Canada Ltd. explored the base metal potential of the Horseshoe Lake greenstone belt from 1971 to 1973. A Questor airborne survey was flown in 1971 and ground follow-up work was carried out over 7 selected areas. A drill hole inclined 50° from horizontal tested a geophysical anomaly at location 5 on Figure 4.3. This drill hole intersected a zone of massive pyrite at 58.8 m. An assay of a 30 cm interval including the pyrite zone returned 0.54% Cu, 0.01% Zn and 0.07% Ni. The pyrite zone was hosted by a chlorite-hornblende gneiss (File no. 53 B/02NE-0010, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout).

The Staff Geologist did not examine the site of this mineral occurrence.

RECOMMENDATIONS FOR EXPLORATION

Gold mineralization in the Horseshoe Lake greenstone belt is associated with northeast-trending faults (Shear Zone occurrence) and boundary-zone faults (Sulphide Zone occurrence, Rust Seep zone) as mapped by Jensen (1989). Gold mineralization is also associated with northwest-trending structures as at the Sanderson occurrence. Further gold exploration in the Horseshoe Lake greenstone belt should include prospecting focussed on the fault zones mapped by Jensen (1989).

The base metal potential of the Horseshoe Lake greenstone belt appears to be in the eastern portion of the Calc-Alkalic Domain (Jensen 1989).

C.L. Boland Copper-Nickel Occurrence

LOCATION AND ACCESS

The C.L. Boland occurrence is located approximately 56 km west of Pickle Lake in the Wettlaufer Lake area. The occurrence is 1.2 km southwest of Heinz Lake on the west side of a creek that connects Heinz Lake to the Meen River. At this locality, the occurrence is located on the east side of a knoll forested by jack pine—the surrounding area is a black-spruce swamp. The knoll is approximately 400 m north of the Meen River. The occurrence can be accessed by float plane via Heinz or Wettlaufer lakes and then by canoe or foot along the appropriate waterway(s) (Figure 4.5).

TABLE 4.5. Geochemical analyses for the C.L. Boland occurrences.

Sample No.	Sample Type	Au ppb	Ag ppb	Cu ppm	Ni ppm	Pt ppm	Pd ppb
GWS-91-17	chip[1]	<2	<2	748	202	2	10
GWS-91-18	grab	6	<2	2313	690	2	14
GWS-91-19	grab	<2	<2	558	535	<1	11

[1] Note: chip sampling of GWS-91-17 collected over 1.5 m distance.

EXPLORATION HISTORY

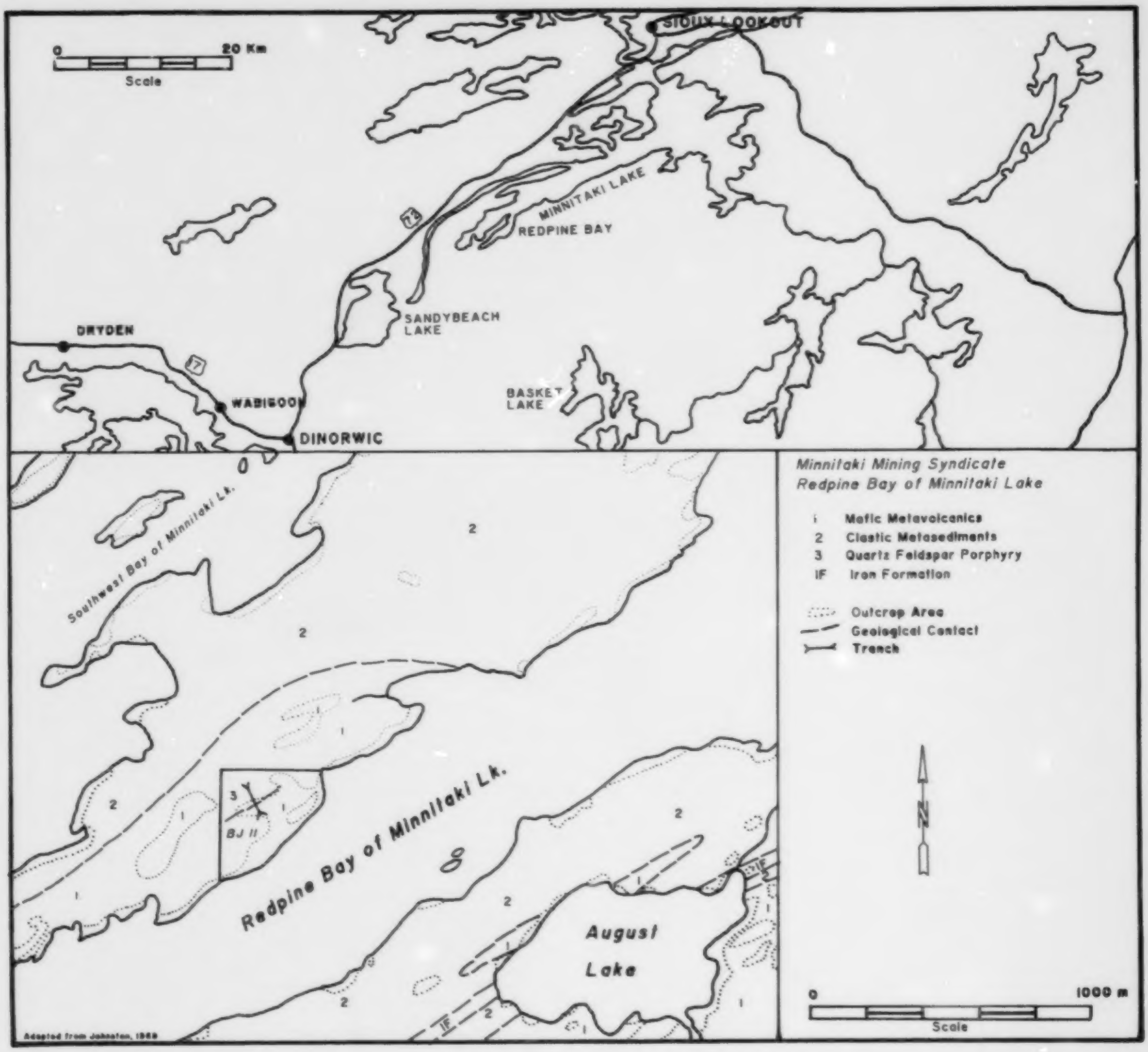
During or prior to 1969, C.L. Boland, a prospector, discovered copper-nickel mineralization on the west side of the creek draining Heinz Lake. He staked a 27 claim property to cover the discovery. Bochawana Copper Mines Ltd. acquired the property from C.L. Boland in 1969. Trenching and a 3 hole diamond-drilling program, totalling 229 m, tested the mineralization that same year. A channel sample, taken from one of the trenches, returned 3.62% Cu, 0.08% Ni and 15.17 g/t Ag over 1.83 m (Files nos. 52 O/11SW-0037 and 52 O/11SE-0010, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). In 1970, Bochawana Copper Mines Ltd. performed line cutting, a magnetometer survey and an electromagnetic survey. This was followed in 1971 with 8 diamond-drill holes totalling 1069 m. The best drill intersection from the C.L. Boland occurrence is 1.10% Cu and 0.17% Ni over 0.91 m (File no. 52 O/10SW-0011, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). No work has been reported on this occurrence since 1971.

GEOLOGY

The C.L. Boland occurrence is located near the east end of the Lang Lake greenstone belt. Fenwick and Srivastava (1972) mapped the geology of the Lang Lake greenstone belt. The area around the occurrence is mapped as foliated, mafic to intermediate metavolcanic lavas with subordinate pyroclastics of similar composition. The foliation trends east.

PROPERTY EXAMINATION

The occurrence is located about 400 m north of the Meen River on terrain consisting of a combination of bedrock and


SIOUX LOOKOUT
0
20 Km
Scale
MINNITAKI LAKE
REDPINE BAY
72
SANDYBEACH LAKE
DRYDEN
17
WABIGOON
DINORWIC
BASKET LAKE
Southwest Bay of Minnitaki Lk.
Redpine Bay of Minnitaki Lk.
BJ II
August Lake
IF
1
2
3
Minnitaki Mining Syndicate
Redpine Bay of Minnitaki Lake
1 Mafic Metavolcanics
2 Clastic Metasediments
3 Quartz Feldspar Porphyry
IF Iron Formation
Outcrop Area
Geological Contact
Trench
N
0
1000 m
Scale

Adapted from Johnston, 1969

Figure 4.6. Location map for and geology of the Minnitaki Mining Syndicate property, Redpine Bay of Minnitaki Lake.

sand ridge. Bedrock outcrops on the east and south sides of the knoll. Two trenches cross the knoll. Only the east trench exposes bedrock and the sulphide mineralization. All of the bedrock exposures around the knoll are of dark-green, fine-grained, weakly foliated amphibolite. The foliation strikes 270° and dips 70° to 90°N. The east trench is 20 feet long, north to south. Sulphide mineralization is evidenced by bands of gossan on the face of the trench. Chips off the gossan-stained areas revealed low concentrations of sulphide. According to the observations of the Staff Geologist, the blast-ejected rock around the trench contains the best mineralization. The mineralization consists of stringers and fractured fillings of chalcopyrite and pyrrhotite. The highest concentration of total sulphides is approximately 2%.

A 1.5 m chip sample and 2 grab samples were taken by the Staff Geologist and analyzed for Au, Ag, Cu, Ni, Pt and Pd at the Geoscience Laboratories Section, Ontario Geological Survey, Toronto. Table 4.5 contains the results.

Minnitaki Mining Syndicate Property (Redpine Bay of Minnitaki Lake)

In 1990 and 1991, the Sioux Lookout office Geological Secretary integrated historical newspaper clippings with the Sioux Lookout Mineral Deposit Files. This revealed a set of historical newspaper articles that did not correspond to known mineral occurrences. The information contained in several of the articles suggested the presence of forgotten mineral occurrences. For example, 2 of the newspaper articles referred to a find by the Minnitaki Mining Syndicate on

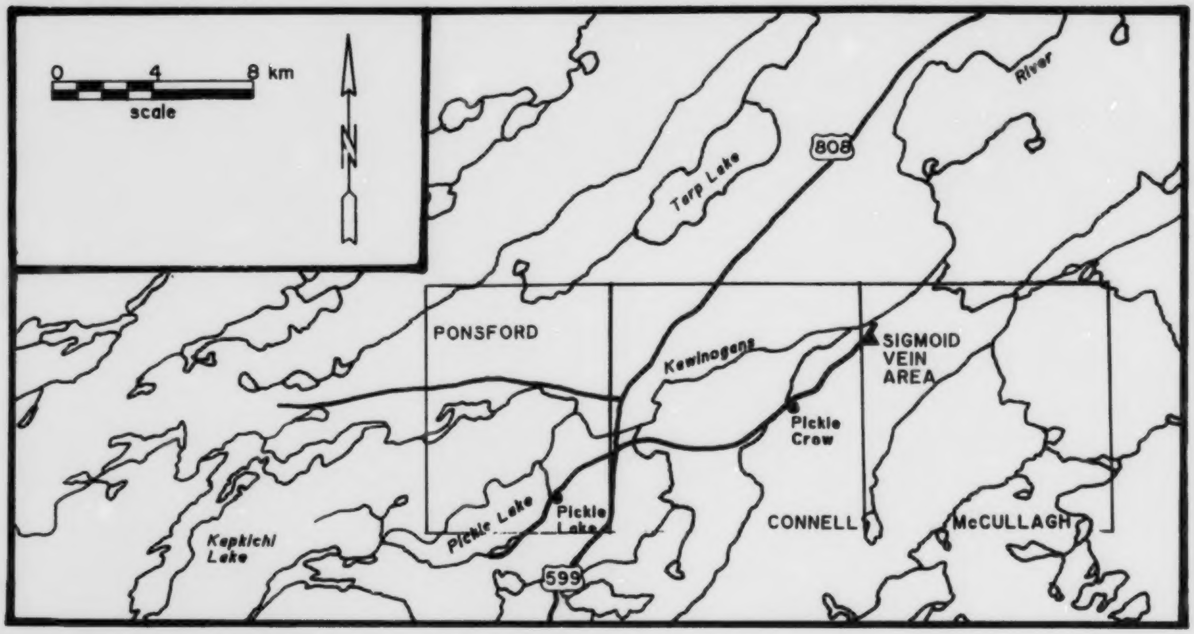


Figure 4.7. Location map for the Sigmoid Vein area, Pickle Crow Project.

Redpine Bay of Minnitaki Lake. One of the articles, in the *Pre-Cambrian Magazine* (January, 1934, p.12), refers to the occurrence in general terms and gives incorrect information. The second article, from an unknown publication, is more detailed and agreed with recent field observations. Copies of both articles are available for viewing at the Resident Geologist's office, Sioux Lookout. What follows is the report as printed in that aforementioned second, unknown-source article:

> *SPECTACULAR GOLD FIND NEAR SIOUX LOOKOUT SHOWS PROMISE*
>
> An important gold find was made last fall in the Sioux Lookout area—unusually significant in the sense that it may become the turning point in the hitherto colourless story of the old Minnitaki gold belt. The details to hand are from members of the Minnitaki Mining Syndicate—Sioux Lookout citizens who control the discovery made by a local prospector named R. McKenna and his partner.
>
> The discovery claim is on a peninsula striking northeast as it separates Red Pine Bay [*sic*] from Southwest Bay at the southern extremity of Minnitaki Lake. The distance from Sioux Lookout is about 22 miles—about a four hour "kicker" run without a portage.
>
> Dr. M.E. Hurst's recently produced geological map of the district shows the greenstones and Temiskaming sediments forming a contact zone partly down the centre of this long promontory. The map does not show the numerous porphyry dikes that intrude these formations.
>
> The particular porphyry dike in which the gold was found in two places widely apart is situated about half way down the peninsula on the west shore of Red Pine Bay. Where the find was made the dike is about 200 feet wide and traceable across two claims. Spectacular samples of gold were secured from a group of quartz stringers near the footwall of the dike. A single shot revealed much gold. The second discovery was about 300 feet northeast of the first find. It consisted of visible gold in a six inch stringer of quartz. The dike itself which is a feldspar porphyry is mineralized with iron pyrites in coarse cubes, but fine sulphides appear two feet below the surface. Stringers of quartz appear throughout the dike, or wherever the surface has been exposed in an area having an average overburden of three to four feet. To date, only two trenches have been run in an effort to reach the contact between the porphyry and the sediments. Surrounding rocks show a decisive shearing movement. Even where no quartz appears there is in evidence much general mineralization— iron pyrites, chalcopyrite, and sphalerite. Where exposed the dike is sheared and oxidized. Iron formation outcrops at various points within the eight claims staked. Rhyolite appears on the north claims and more porphyry dikes show up in the sediments. The Algoma granites lie to the east of Red Pine Bay. Between the granite and the property the rocks indicate a deep shearing movement. Aplite dikes, narrow bands of iron formation and other rock phases are much in evidence.
>
> Shortly after the discovery was made an extremely hard winter set in a month earlier than usual thus rendering exploratory work impossible. As soon as snow goes the syndicate intends serious investigation of ground which, because of its geological setting and mineralization, has unquestioned merit.

Redpine Bay of Minnitaki Lake is located 27 km southwest of Sioux Lookout (Figure 4.6). Access is by boat via Abram Lake from Sioux Lookout. Forest-access trails off the Basket Lake road approach within 2 km of the southwest end of Redpine Bay.

Other than the 2 above-mentioned articles, there is no other record of exploration work having occurred on the peninsula between Redpine Bay and Southwest Bay of Minnitaki Lake.

Hurst (1932) and Johnston (1969) mapped the geology of the Minnitaki Lake area. Both geologists found the penin-

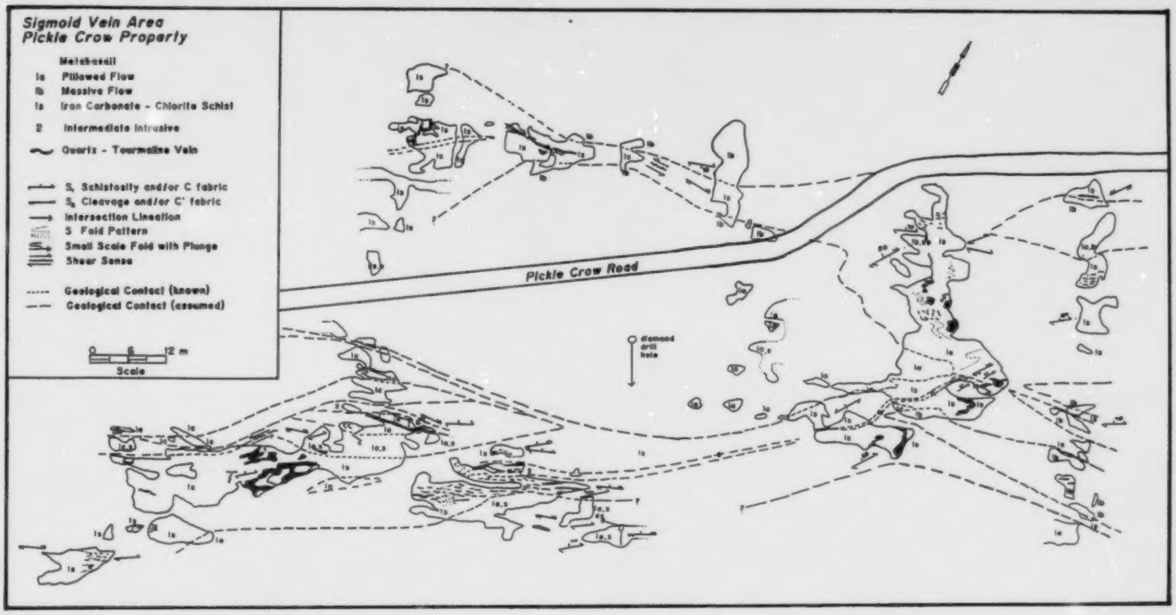

Sigmoid Vein Area
Pickle Crow Property
Metabasalt
1a Pillowed Flow
1b Massive Flow
1s Iron Carbonate - Chlorite Schist
2 Intermediate Intrusive
Quartz - Tourmaline Vein
S_1 Schistosity and/or C fabric
S_2 Cleavage and/or C' fabric
Intersection Lineation
S Fold Pattern
Small Scale Fold with Plunge
Shear Sense
Geological Contact (known)
Geological Contact (assumed)
0 6 12 m
Scale
Pickle Crow Road
diamond drill hole

Figure 4.8. Geology of the Sigmoid Vein area, Pickle Crow Project.

sula between Redpine Bay and Southwest Bay of Minnitaki Lake to be underlain by metasediments to the north and mafic metavolcanics to the south. Both Hurst (1932) and Johnston (1969) show mining location BJ11 on their respective geological maps. The writers of the present report focussed their prospecting efforts around mining location BJ11 as it was probably part of the original Minnitaki Mining Syndicate property. An examination of the shoreline outcrops, along the north shore of Redpine Bay, found massive and pillowed metabasaltic flows. The writers observed several narrow quartz veins, with various attitudes, within the metabasaltic flows. These quartz veins do not contain sulphides and are apparently barren. A narrow, fresh feldspar porphyry of mafic to intermediate composition crops out near the middle of the shoreline exposure on mining location BJ11.

The writers traversed north along the approximate west boundary of mining location BJ11. About 300 m inland is a large outcrop of mafic metavolcanics. About 100 m east of that outcrop is an outcrop of fresh-looking, quartz-feldspar porphyry on the north side of a ridge of mafic metavolcanics. Northeast along the contact between the porphyry and the metavolcanics are the 2 trenches referred to in the earlier-quoted article. The trenches, about 8 m apart, trend north. The west trench extends from well into the mafic metavolcanics to a point over 70 m north which is down a slope and into a ravine. The quartz-feldspar porphyry in the trench has a width of at least 60 m. At the northernmost exposure in the trench, the quartz-feldspar porphyry is well sheared and carbonatized. Locally, it contains an apple-green mica and up to 1% disseminated pyrite. The writers took three grab samples at this location. The best result among the analysis values obtained returned 645 ppb Au (Geoscience Laboratories Section, Ontario Geological Survey, Toronto).

The second trench is slumped in and has no bedrock exposure. Further prospecting failed to locate the quartz vein to the northeast of the 2 trenches, as was mentioned in the quoted article. The writers believe further prospecting of the Redpine Bay area is warranted.

The Pickle Crow Project: Sigmoid Vein Area

In September of 1991, the Staff Geologist commenced a multiyear project to map in detail the many surface gold occurrences on the Pickle Crow Gold Mines Ltd. and Central Patricia Gold Mines Ltd. properties near Pickle Lake. The objective of this project is to determine the structural controls on gold mineralization of past producers in this area.

The Sigmoid Vein area is located at the northeast end of the Pickle Crow Gold Mines patented claims (Figure 4.7). Here, a shear system hosting a number of discontinuous quartz veins is exposed in a network of trenches and stripped areas. Approximately 40% of a 200 by 100 m area is exposed by the stripping and trenching. An additional 30% of the area is partially exposed outcrop.

The Staff Geologist mapped the Sigmoid Vein area at a scale of 1:240. This enabled the plotting of detailed observations directly on the map. A simplified map at a reduced scale is given in Figure 4.8.

Metabasalt is the main rock type found in the Sigmoid Vein area. Where it is not intensely sheared, the metabasalt exhibits textures consistent with a sequence of massive and pillowed flows. The metabasalts are fine to medium grained and weather to a pale green. Where intensely sheared, the

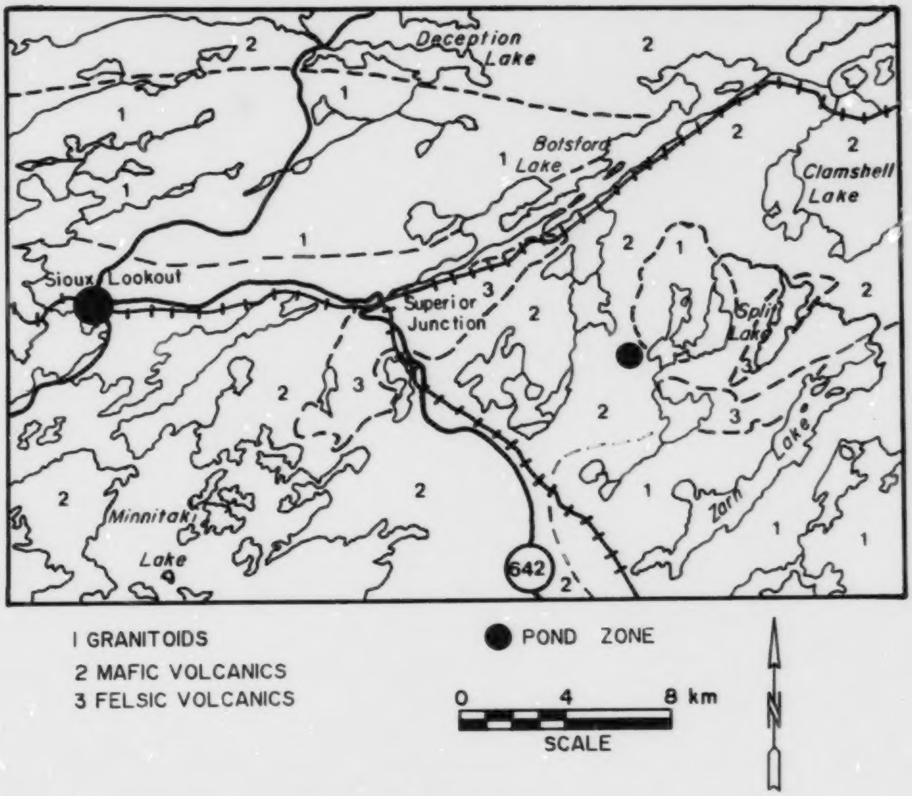


Figure 4.9. Location map for the Pond Zone—Alcona Mines property.

metabasalts are converted to finely laminated iron carbonate-chlorite schists. The contacts between the intensely sheared and more massive rocks are gradational. Quartz veins and an intermediate intrusive are the only other rock types found in the Sigmoid Vein area.

The intermediate intrusive is medium-grained and has a salt-and-pepper-like texture. It intruded metabasalt as a thin dike or dike set that is now transposed and folded along various shear zones.

There are at least 3 types of quartz veins in the Sigmoid Vein area. All are composed of white quartz, black tourmaline and 1 or more of iron carbonate, pyrite and visible gold. The first type of quartz vein is folded and boudinaged. Locally, this first type of vein carries spectacular visible gold. An 86 cm chip sample taken across a folded vein near the east end of the stripped area assayed 33 g/t Au (Temiskaming Testing Laboratories, Cobalt). All other samples of this vein type yielded nil or trace Au.

The second type of quartz vein occurs as thin laminae intersheared with the iron carbonate-chlorite schist. This second type of vein is often pytgmatically folded. The third type of quartz vein occurs in fractures at high angles to the main shearing direction. This vein type is commonly shallow dipping. Veins of the third type may have formed late in the history of the Sigmoid Vein area.

The structures observed in the Sigmoid Vein area are complex. Small-scale folds of the schistosity in the iron carbonate-chlorite schists, the geometric distribution of that same rock type and of the type 1 quartz veins all suggest a tight fold or possibly even a basin-and-dome structure. Other structures, such as small-scale chevron-style folds, C-C' fabrics and anastomosing shear zones, are not consistent with a complex fold structure.

Stott and Brown (1986) suggest that the shear zones in the Pickle Crow Mine area formed along conjugate fractures at low angles to the principal-flattening schistosity. The structures observed in the Sigmoid Vein area may conform to this model. However, they may also be part of a large deformation zone as defined by Colvine et al. (1988). Further work in the Pickle Crow area by the Staff Geologist will attempt to determine which model best conforms to the exposed structure.

Pond Zone—Alcona Mines

LOCATION AND ACCESS

The Alcona Mine is located near Split Lake, approximately 13 km northeast of the town of Sioux Lookout (Figure 4.9). The property can be reached by a 6 km access trail off Highway 642, to the east of Sioux Lookout. The trail can be traversed by all-terrain vehicles in summer and winter. Alternatively,

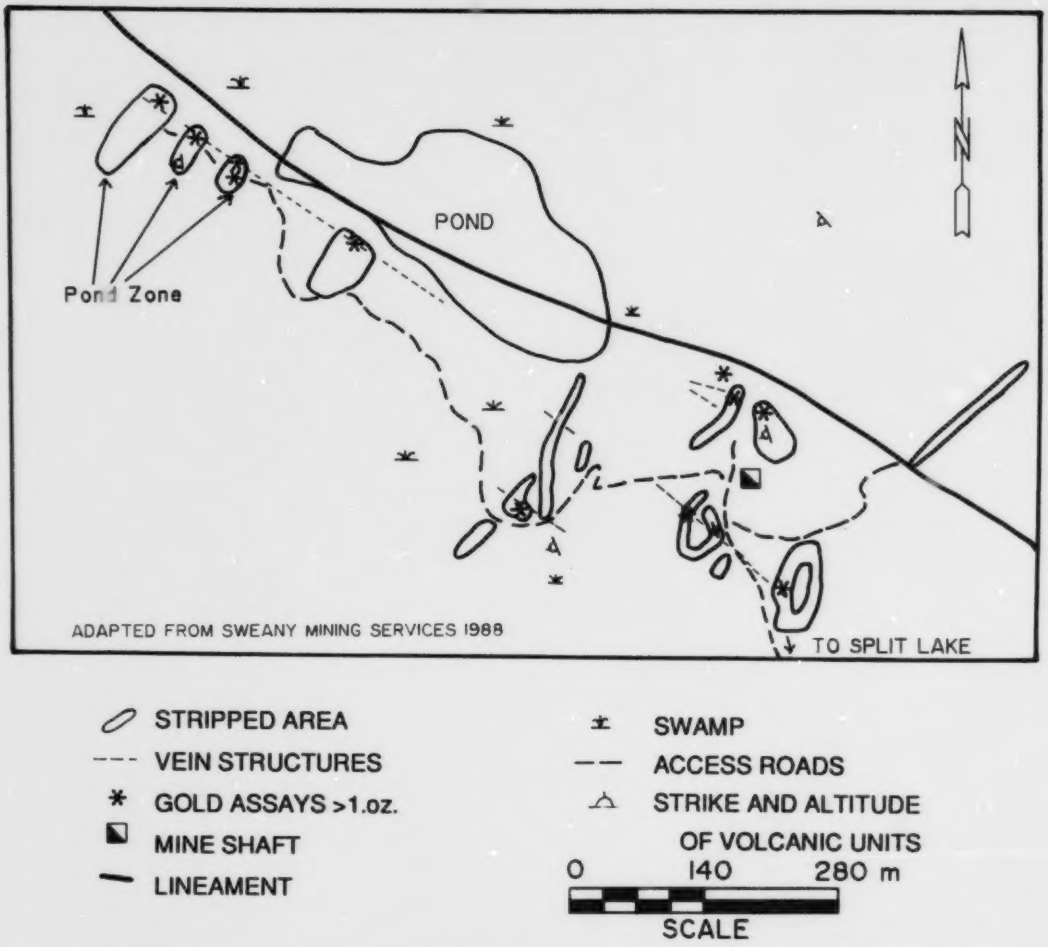


Figure 4.10. 1989 stripping program—Alcona Mines property (D. Sweaney, Sweaney Mining Services, written communication, 1988).

float-equipped aircraft can land on Forty Mile Lake and from here access may be gained using a series of trails at the north end of the lake, near the creek which flows into Split Lake.

EXPLORATION HISTORY

The gold occurrences were discovered in 1929 by G. and S. Michaud of the village of Alcona. The property was optioned to Consolidated Mining and Smelting Co. of Canada which conducted a trenching program in 1929.

In 1930, the Atlas Exploration Co. took over the claims and opened up several gold-bearing quartz veins.

In 1932, Alcona Gold Mines Ltd. took over the property and, by 1935, had sunk a 3 compartment shaft to 325 feet with levels at 180 and 305 feet. A bulk sample was taken and assayed; it returned 2.94 ounces Au per ton and 10.01 ounces Ag per ton with 3.1% Pb, 0.43% Cu and 0.5% Zn (File no. 52 J/04SE-0014, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). Extractive tests of gold by amalgamation and cyanidation gave poor recovery. This may indicate a problem with ore mineralogy or reflect the limits of technology at the time.

In 1939, Alcona Mines Limited conducted drilling and sampling in the area of the shaft. No further exploration was done on the site until 1979 when the property was optioned to Oriana Developments Limited. Oriana Developments Limited drilled several holes on the No.1 and No.2 veins but did not significantly improve upon the performance of previous results. In 1980, the property was optioned to Ajax Resources Limited.

By 1987, all claims over the Alcona Mines property had lapsed and the property was staked by prospectors R. Knappett, K. Bernier and D. Sweaney. Subsequently, the property was optioned to Cream Silver Mines Ltd., which greatly increased the claim block to include the Split Lake Mine property to the east of the Alcona Mine site.

In 1988, Cream Silver Mines Ltd. engaged Sweaney Mining Services to carry out an extensive program of stripping, geophysical surveying and sampling on the claim block.

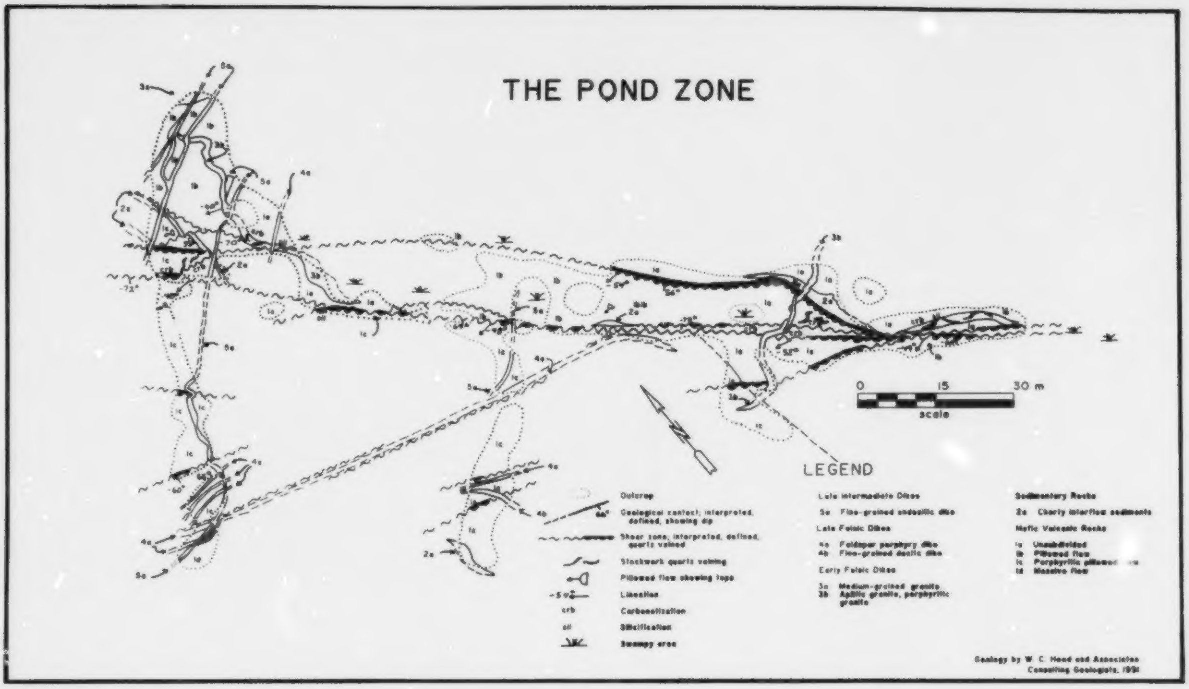

THE POND ZONE
0
15
30 m
scale
LEGEND
Outcrop
Geological contact; interpreted, defined, showing dip
Shear zone; interpreted, defined, quartz veined
Stockwork quartz veining
Pillowed flow showing tops
Lineation
crb Carbonatization
sil Silicification
Swampy area
Late Intermediate Dikes
5a Fine-grained andesitic dike
Late Felsic Dikes
4a Feldspar porphyry dike
4b Fine-grained dacitic dike
Early Felsic Dikes
3a Medium-grained granite
3b Aplitic granite, porphyritic granite
Sedimentary Rocks
2a Cherty interflow sediments
Mafic Volcanic Rocks
1a Unsubdivided
1b Pillowed flow
1c Porphyritic pillowed flow
1d Massive flow
Geology by W. C. Hood and Associates Consulting Geologists, 1991

Figure 4.11. Geology of the Pond Zone—Alcona Mines property (W.C. Hood and Associates Consulting Geologists, written communication, 1991).

In 1991, Valerie Gold Resources Ltd. optioned the Alcona Mines property from Cream Silver Mines Ltd. and carried out a program of diamond drilling, trench mapping and sampling (W. Hood, W.C. Hood and Associates Consulting Geologists, personal communication, 1991) The results of this program were not available at the time of writing.

REGIONAL GEOLOGY

The geology of the Superior Junction area, which includes the Alcona Mine and the Split Lake Mine, is described in a report by Horwood (1937). Horwood described in detail the vein systems on the Alcona Mine property. The most recent Ontario Geological Survey mapping was done in 1978 by Page and Moller (1979a, 1979b).

The area surrounding Split Lake is underlain by the Northern volcanic belt of the western Wabigoon Subprovince (Turner and Walker 1973). The northern limit of this belt is in fault or intrusive contact with the English River gneissic terrane. The northeast-trending Miniss Fault passes through Botsford Lake, near the contact with the English River terrane and the Northern volcanic belt, and approaches within 6 km of the Alcona Mine deposits. Metabasalts of the Northern volcanic belt underlie most of the area near the mine. Two metabasalt varieties underlie the area and trend northwest and are structurally facing to the southwest. A distinctive feldspar-porphyritic pillowed basalt underlies half of the mine area. Interbedded with the porphyritic metabasalt is a fine-grained, variably sheared, dark-green metabasalt with pillowed and massive phases. Dikes of both varieties cut most outcrops. Intruding this volcanic suite is the Split Lake Stock, an elliptical, quartz diorite to granodiorite pluton with major and minor axes of 5 km and 3 km, respectively. The Split Lake Stock carries oriented blocks of foliated metabasalt near its southern contact with the metavolcanics.

Four outcrop areas of felsic volcanic rocks are located near the stock. The closest is near Forty Mile Lake and is located within 1.5 km of the Alcona Mine. A wide variety of mafic to felsic dikes cut all rock types other than the Split Lake Stock. At least 2 varieties of feldspar-porphyry dikes are present, along with carbonate-replaced, mafic dikes. Fresher porphyritic and aphanitic mafic dikes are probably related to the mafic volcanic suites. A late, fresh aplitic dike is related to the Split Lake Stock. All of these dikes are rotated or folded near the Pond Zone deposit; however, aplite may be injected into a folded zone and may postdate folding.

PROPERTY EXAMINATION

Figure 4.10 shows the location of older workings and recent trenches on Cream Silver Mines Ltd.'s Split Lake property. The 3 veins near the shaft were trenched where possible and explored by drilling. A 350 foot, vertical, 3 compartment shaft was sunk in the late 1930s. Drifts were driven at 180 foot and 350 foot levels. None of the veins explored on surface were located underground (Horwood 1937).

The quartz-carbonate vein northwest of the shaft (the Pond Zone) was trenched but not drilled. During staking of the property in 1987, K. Bernier located a series of old pits on a hillside, south of the pond. A vein or veins exposed in

TABLE 4.6. Channel samples—Pond Zone.

No.	Width	Grade		Description
		Gold oz./t	Silver oz./t	
1	12"	0.12	0.23	qtz vein in carbonate basalt
4	8"	0.24	1.23	qtz vein in carbonate basalt
5	6"	0.47	0.16	qtz vein in carbonate basalt
6	10"	0.05	0.19	qtz vein in carbonate basalt
12	18"	0.08	0.11	qtz-carbonate alteration
13	12"	0.90	1.80	qtz vein
14	15"	0.24	0.15	qtz vein
16	24"	0.25	1.12	qtz vein
17	24"	0.10	0.70	qtz vein
19	12"	0.13	1.0	qtz vein

these pits carried pyrite, chalcopyrite, galena and sphalerite in a quartz-carbonate gangue. Grab samples had assayed up to 2.94 ounces Au per ton and up to 10 ounces Ag per ton (File no. 52 J/04SE-0014, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout)

As part of a program of stripping and geophysics conducted by Sweaney Mining Services, a large area including these trenches was stripped and sampled (*see* Figure 4.10). The geology is similar to that underlying the shaft area. Relatively massive feldspar-porphyritic metavolcanic flows are interlayered with variably sheared metabasalts—the massive andesite of Horwood (1937). Beds trend northwest and dip between 50° and 60°SW.

Figure 4.11 is a simplified map of the stripped area. The porphyritic metabasalts are relatively undeformed but are highly silicified near the contact with the massive metabasalts. By contrast, the massive metabasalts are foliated to sheared and are carbonate replaced in part. A strong cleavage is developed at the west end of the outcrop area. The cleavage trends from 280° to 310° and truncates near the limit of outcrop with a series of fine M-folds with a 40° axial plunge. A series of contorted dikes of at least 5 generations are exposed in the trench areas. The veins are folded and trend parallel to the cleavage. The veins have carbonatized, sulphide-containing contacts with the metabasalt.

Sweaney Mining Services conducted a sampling program over the Pond Zone but did not report any results. The Sioux Lookout Resident Geologist's office sampled some of the channels and the results are reported in Table 4.6 (Temiskaming Testing Laboratories, Cobalt).

The Mac-Read Gold Prospect, Sturgeon Lake

LOCATION AND ACCESS

The Mac-Read prospect, also known as the MacDonald-Read prospect, is located on the north shore of King Bay near the bay's west end (Figure 4.12). The prospect is approximately 400 m due north of the mouth of a small, south-flowing creek. The Armstrong-Best gold prospect is located 200 m north of the same creek mouth. Directly opposite the creek mouth on the south shore of King Bay are 2 shafts and an adit of the Shores prospect on patents AL 367 and AL 368.

The Mac-Read prospect can be accessed by boat or float-equipped aircraft in summer. A trail leads north from the creek mouth to the Armstrong-Best prospect and then to the Mac-Read prospect. A rough skidder trail was cut off the Six Mile Lake forestry-access road and can be travelled by all-terrain vehicles in summer and winter. The Six Mile Lake road joins Highway 599 approximately 1 km south of the Sturgeon Rapids bridge.

EXPLORATION HISTORY

Blue-quartz boulders with gold have been noted by many prospectors working in the King Bay area. In the 1930s, a small mill was set up south of King Bay to process a fan of boulders carrying gold in quartz veins in mafic and quartz-prophyry host rock.

The discovery date of the Mac-Read prospect is not known. Prospectors R.A. MacDonald and W.C. Read were working the property by 1936. T.L. Gledhill wrote a brief report on the property in February of 1937 (File no. 52 J/02SW-0028, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). T.L. Gledhill commented on a small, stripped area and 9 drill holes situated near the west end of the property. During the winter of 1937, Denman Securities of Toronto financed drilling to explore the vein at depth. The drilling program gave little encouragement. A pitting-and-sampling program carried out in 1938 and 1939 increased the known length of the vein system. A section of vein 28.7 m long was sampled along a channel at 1 m intervals and gave an uncut gold content of 0.46 ounce Au per ton. Sylvanite Gold Mines optioned the property in July of 1939 and examined the exposed vein. A section 16.7 m in length had previously been sampled and gave 0.49 ounce Au per ton over 1 m. As a check, Sylvanite Gold Mines Ltd. sampled this section to yield a 13.7 m length grading 1.1 ounces Au per ton over 0.67 m. Sylvanite Gold Mines Ltd. concluded that the tonnage was not sufficient to justify additional work and dropped the option in the fall of 1939 (File no. 52 J/02SW-0028, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout).

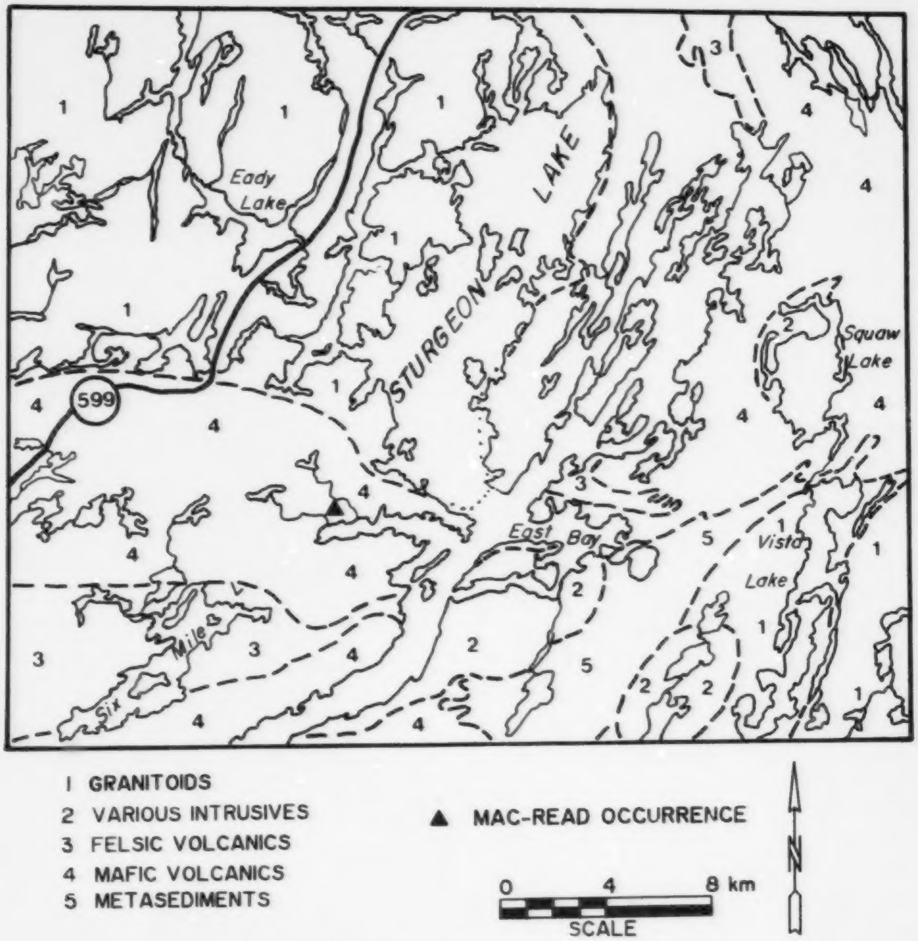


Figure 4.12. Location map for the Mac-Read occurrence.

No additional work was recorded on the property until 1982 when G. Armstrong and A. Best drilled into a new, parallel zone approximately 200 m south of the Mac-Read prospect. A large claim block was staked which included the Mac-Read Prospect. G. Armstrong and A. Best optioned the block to Steep Rock Resources. In turn, Falconbridge Ltd., Hudson Bay Exploration and Almaden Resources examined all or part of the claim block between 1983 and 1987. Surprisingly, little or no work was done on the Mac-Read Prospect. In 1990, Armstrong and Best regained control of the claim block and pumped out the Armstrong-Best showing in order to evaluate it for small-scale mining. At the same time, the Mac-Read prospect was stripped mechanically and the area of exposed vein significantly increased, (A. Best, Prospector, personal communication, 1990). The Resident Geologist examined the property in 1991 and suggested it might have small-scale-mining potential. A. Best has since taken a 1 ton bulk sample of the vein material.

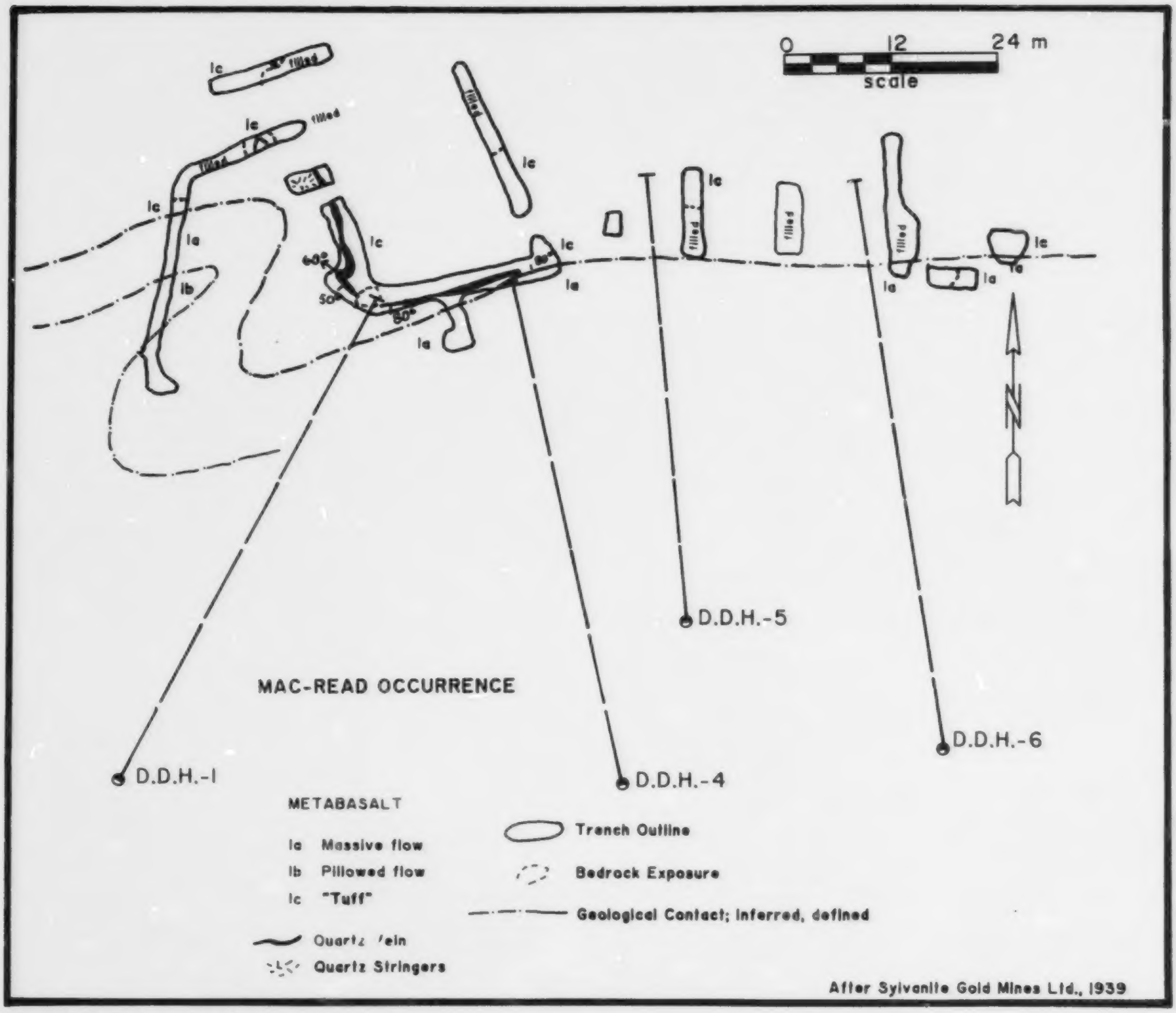
REGIONAL AND LOCAL GEOLOGY

The most recent mapping in the area was done by Robinson and MacLean (1991). They mapped the Six Mile Lake area which reaches the western end of King Bay and reported their findings:

> The geology of the Six Mile Lake area consists of a south-facing, homoclinal sequence of two mafic to felsic volcanic cycles overlain by a third mafic volcanic cycle. The lower mafic to felsic cycle is referred to as the Fourbay Cycle (FBC). The second mafic to felsic cycle is referred to as the Six Mile Lake Cycle (SMC) and the upper-most mafic cycle is the North Sturgeon Lake Cycle (NSC).
>
> Mafic dikes, sills and sheets have invaded the SMC and are volumetrically abundant within this cycle. Quartz-feldspar porphyry and feldspar porphyry dikes and sills are also numerous throughout the second cycle. Two feldspar porphyry stocks, up to 1500 m by 5000 m, occur at and near the stratigraphic top of the second mafic cycle near King Bay and Six Mile Lake.

Robinson and MacLean (1991) describe the pillowed mafic unit of the Six Mile cycle, which is the host for all of the King Bay prospects:

> The lower half of the Six Mile Cycle is dominated by a thick sequence of well-developed pillowed flows, flow breccia



After Sylvanite Gold Mines Ltd., 1939

Figure 4.13. Geology of the Mac-Read occurrence.

> **and thin to thick massive flows. The Pillowed Mafic Unit (PMU) strikes west, dips steeply north and is approximately 5000 to 6000 m thick. Primary textures are locally very well preserved, including sequences of lower massive flow bases immediately overlain by mattress- and tube-size pillows capped by pillow flow breccia. Facing directions throughout the section are consistently south.**
>
> **The pillowed units are generally vesicular/amygdaloidal with interstitial quartz filling pillow interstices and half-moon shaped, quartz-filled structures within pillow interiors.**

PROPERTY EXAMINATION

Both the Armstrong-Best and Mac-Read prospects share common characteristics. Both deposits are hosted in south-facing, east-trending, pillowed metabasalt units. Both are hosted in carbonate and silica-replaced zones and have grey-to blue-coloured quartz. So called "iron formation" is present in both prospects; in fact, a rusty, sulphidized zone would be a better description. Gold tenor in both prospects tends to follow sulphide content, though the certainty of this is not as clear in the poorly exposed Armstrong-Best prospect. The Mac-Read prospect has a clearly defined fold structure; the Armstrong-Best prospect may be folded, but the exposure is insufficient to confirm this.

The time available before snowfall at the Mac-Read prospect was too short to do detailed mapping in 1991, however, several observations were made. The outcrops previously identified as "tuff" are sheared mafic metabasalts (Figure 4.13). The metabasalts are pillowed and massive flows interbedded with thin (up to 3 m wide) feldspar-porphyry dikes. The stripping done by G. Armstrong and A. Best reveal a package of west-trending pillowed basalts which are sheared or folded in a northwest direction at the west end of the exposure. Between the pillowed units is a sequence of "tuff" and feldspar porphyry. The porphyry is intruded by blue- to black-coloured quartz veins containing 2% to 15% pyrite. The veins pinch and swell and range between 0.6 and 1 m. The recent stripping has extended the vein structure to the east where the zone appears to pinch out. The north side of the pit contains another bed of "tuff" so that additional stripping to define the contact with the pillowed mafic volcanics is recommended. A prominent "iron formation", or sulphidized zone, is present in 1 porphyry dike. The porphyry contains 2% to 5% sulphides.

CONCLUSIONS AND RECOMMENDATIONS

The original work done by R.A. MacDonald and W.C. Read in 1937 gave a tonnage factor of 21 tons per vertical foot at a grade between 0.5 to 1 ounce Au per ton (File no. 52 J/02SW-0028, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). This may be extended if sampling of the eastern portion of the zone carries gold at the same tenor. Additional stripping to the north and an induced-polarization or horizontal-loop survey may disclose additional gold-bearing vein extensions. While the tonnage potential is limited, the MacRead Prospect is not prone to flooding and would be a better candidate for small-scale mining for that reason.

DRILL CORE LIBRARY PROGRAM

The Kenora Drill Core Library serves 3 of the 6 Resident Geologists' districts in northwestern Ontario: Kenora, Sioux Lookout and Red Lake. Drill core stored consists of drill core from entire drill holes from both exploration and mine-development drilling, incomplete drill core recovered from old drill sites, and short samples of drill core submitted for credit under section 77(6) of the former Mining Act. Table 4.7 provides a summary of drill core from the Sioux Lookout Resident Geologist's District.

The library holds 19744.7 m of drill core from 219 drill holes in the Sioux Lookout Resident Geologist's District, 14257.5 m (165 holes) inside the building and 5487.2 m (54 holes) in outdoor storage.

Gold remained the primary exploration target in the Sioux Lookout district, and the drill core collected during 1991 was from gold-exploration programs. D.E. Smith drilled a claim group on Vermilion Lake which was optioned from Acadia Mineral Ventures Ltd. in 1988. The rocks described in the logs are mafic volcanic sediments and quartz-feldspar porphyry of the Patara Sediments (Turner and Walker 1973) In 1990, C. Kuryliw drilled 1 hole on a gold property near Neepawa Island in Minnitaki Lake; assays of the core gave only low gold values (assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout).

A large amount of drill core was obtained during the 1960s and 1970s by Algoma Steel Corporation which conducted drilling on many iron deposits in the Lake St. Joseph and Pickle Lake areas. This drill core is stored in Sault Ste. Marie. Negotiations for this material were delayed and it was not possible to collect this material during 1991. It is scheduled to be collected in January of 1992. This material is important in that many of the properties may have gold, base metal or even rare-element pegmatite potential. The only assays on the samples were carried out for iron.

Drilling directed specifically towards building stone or industrial minerals has not been reported in the Sioux Lookout Resident Geologist's District in recent years.

RECOMMENDATIONS FOR EXPLORATION

Gold

Many of the gold prospects in the southern portion of the Sioux Lookout district have had exploration conducted on them over the past 10 years. With the scarcity of exploration funds, it is rather difficult to fund exploration on new showings unless they have dimensions and greater potential than is normally discovered in initial prospecting. For this reason, prospectors have been facing increasing difficulties in optioning new or old gold occurrences. An alternative method of acquiring funds and maintaining working capital for prospecting is the possibility of small-scale mining of near-surface gold deposits. This is not a new idea. A number of prospectors in the northwestern part of the province have done small-scale mining with variable success. Several of the deposits described within this report in the Sioux Lookout Resident Geologist's District appear to have some potential for small-scale mining.

In the Resident Geologist's opinion, the following conditions are required for a reasonable expectation of success in small-scale mining:

1. The gold should be relatively coarse grained so that gravity methods can recover a high percentage of the gold.

2. The sulphide content of the ore should be relatively low. This will aid in gravity separation.

3. Depending on local conditions and the width of the mineralized zone, a minimum grade of 0.5 ounce Au per ton is required, with 1 ounce Au per ton as the desired grade.

4. The width to length ratio should be such that several thousand tons can be removed from surface to make the property economically viable. This is based on the fact that underground mining, other than in exceptional circumstances, is more costly to set up and must meet more detailed regulations than surface mining.

Given these conditions, several properties in the Sioux Lookout area should be investigated to see if small-scale mining is a possibility. Both the Pond Zone occurrence (Split Lake area) and the Mac-Read prospect (King Bay of

TABLE 4.7. Summary of Sioux Lookout Resident Geologist's District drill core.

AREA	NTS	COMPANY	HOLES
Beckington Lake	52J/02NE	Coastoro Res. L.	2
		Grandad Res. L.	1
		Mine L. Res. L.	8
		Villeneuve Res. L.	1
Bell Lake	52G/15SW	Minnova Inc.	5
Conant Twp.	52J/07NE	Noranda Inc.	1
Connell Twp.	520/08NE	Gallant Gold Ms. L.	9
	520/09SE	Kerr Addison Ms. L.	3
		Silverside Res. Inc.	3
Coucheemoskog Lake	520/08SE	Power Expl. Inc.	22
Drayton Twp.	52J/04SW	Nahanni Mines L.	2
Echo Twp.	52F/16NW	Braeswood Expl. L.	11
		Rio Tinto Cdn. Expl.	7
Fourbay Lake	52J/02SW	Riverton Res. Corp.	4
		Steeprock Res. L. (Wahlex L.)	3
Fry Lake	520/03NW	Umex Inc.	12
Johnston Bay	520/03SE	Kerr Addison Ms. L.	7
Jutten Twp.	52J/07SE	Westmin Resources L.	3
Kawashe Lake	520/06SE	Ateba Mines L.	5
Kecheokagan Lake	52B/02NW	Great Plains Dev. Co.	3
Lomond Twp.	52K/01SW	Nahanni Mines L.	1
Nemeigusabins L.	53H/12SW	Platinum Expl. Cdn. Inc.	9
Parnes Lake	52G/13NW	Denison Mines Ltd.	2
		Kuryliw, C. J.	1 *
Penassi Lake	52G/14NE	Noranda Inc.	1
Pickerel Township	52F/16NE	Quyta Gold Mines Ltd.	10
		Realmont Red Lake Gold Mines Ltd.	3
		Tarbush Lode Mng. Inc.	7
		Tri Origin Expl. Ltd.	2
	52F/16NW	Tri Origin Expl. Ltd.	1
Sixmile Lake	52G/15NW	Noranda Inc.	2
		Santana Petroleum Corp.	10
Smock Lake	52G/13NE	BHP-Utah Mines	3
Squaw Lake	52J/02SE	Alotta Resources Ltd.	3
		MPH Consulting Ltd.	3
		Villeneuve Res. Ltd.	1
Tarp Lake	520/09SE	H. J. Hodge Inc.	9
		Kerr Addison Mines L.	2
Vermilion Twp.	52K/01SW	Smith, Donald E. (Acadia Mnrls. Ventures L. opt.)	4 *
	52K/02SE	Moneta Porcupine Ms. L.	6
Whipper Lake	52K/01SW	Nahanni Mines Ltd.	1
Zarn Lake	52J/04SE	Goldwinn Resources	3
		Kerr Addison Ms. Ltd.	2

Note: Assessment credit drill-core samples submitted under the old Mining Act (as mentioned in the text) are not included in this table.

*Indicates drill core added since November 25, 1990.

Sturgeon Lake) would appear to have potential for small-scale mining. The challenge is to outline economically extractable blocks of ore that are accessible from surface with the required grade and milling characteristics to make these and similar properties economically mineable.

Base Metals

Base metal exploration within the Sioux Lookout Resident Geologist's District is, for the most part, focussed in the Sturgeon Lake area and the area adjacent to the intersection of highways 599 and 516. Other areas of the district, however, are favourable for hosting volcanogenic massive sulphide deposits and are not currently being explored in that regard. Some of these areas are discussed as follows:

1. Southwest of Sioux Lookout, in Pickerel, Echo and McAree townships, Chorlton (1991) has identified hydrothermal alteration "reminiscent of the regional alteration zones associated with base metal massive sulphide deposits". Interested parties may wish to do follow-up investigations on the alteration to locate hydrothermal-vent areas.

2. In the Parnes Lake area, Breakwater Resources Ltd. intersected intermediate to felsic fragmental metavolcanics on the south side of the Minnitaki Iron Formation. The fragmental metavolcanics, not observed by previous workers in the area, contain intervals of barren massive sulphides (File no. 52 G/13NW-0038, assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout). Further work in the area should attempt to map the intermediate to felsic metavolcanics along strike and then follow up with appropriate geophysical and geochemical surveys.

3. In the Caron Lake area, Jensen (1991) mapped a felsic metavolcanic unit along the northern margin of the greenstone belt. Farther to the east, the Staff Geologist observed quartz porphyries containing aluminosilicates and zones of amphibole + garnet + pyrrhotite + chalcopyrite mineralization in drill core from Pure Gold Resources Inc.'s properties in the Lowry Lake and August Lake areas. Further exploration should trace the felsic metavolcanics from the Caron Lake area into the Lowry Lake and August Lake areas and note changes to the hydrothermal-alteration assemblages. The results should then be compared to existing geophysical surveys, and targets could be selected for ground follow-up work.

4. In the Drum Lake and Fry Lake areas, several diamond-drill holes (assessment files, Resident Geologist's office, Sioux Lookout Resident Geologist's District, Sioux Lookout) intersected low-grade zinc and copper mineralization in what are mapped as metasediments. Given that over the past decade several areas across the

province originally interpreted to be underlain by metasediments are now interpreted as underlain by felsic metavolcanics, the metasediments in the Fry Lake and Drum Lake area should be re-examined to determine if they too are felsic metavolcanics. If so, they should be evaluated for their potential for hosting volcanogenic massive sulphide type deposits.

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5. Thunder Bay Resident Geologist's District—1991

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INTRODUCTION

For the third consecutive year, mineral exploration activity has declined dramatically in the Thunder Bay District. It has now reached the level of activity that existed in the mid to late 1970s, a 20 year low. Further decline is expected as numerous companies have recently reduced or terminated operations in this area. Because of the assistance of the Ontario Prospectors Assistance Program and the Ontario Mineral Incentive Program programs a total collapse has been averted. The very active prospectors, with new discoveries and improved occurrences, have not made many option agreements.

Inco Limited's Shebandowan copper-nickel mine was in operation all year. Madeleine Mines Ltd. tested their mill by processing low grade material mined from their open pit.

Amethyst was removed from five quarries and three other sites, (*see* Garland, this volume), and diabase was shipped from one site, (*see* Hinz, this volume).

MINING ACTIVITY

Shebandowan Mine

The Shebandowan Mine, owned by Inco Limited and operated by MacIsaac Exploration Ltd., produced nickel-copper concentrates with an undisclosed amount of cobalt and precious metals. These are transported by slurry trucks to Copper Cliff for smelting. The average annual mill rate is 2000 tons per day, producing 308 tons of concentrate per day.

The employment level climbed to 400 employees. A decline was driven from the 2000 foot level to the 2800 foot level. The lateral works were developed and some production came from these new levels. The mine is located 75 km west-northwest of the city of Thunder Bay. The deposit lies underneath Lower Shebandowan Lake (Figure 5.1).

ADVANCED EXPLORATION ACTIVITY AND DEVELOPMENT

Madeleine Mines Ltd., Lac des Iles

On December 17, 1990, Madeleine Mines Ltd. began the first of many test runs of its Lac des Iles mill, located 75 km north of the city of Thunder Bay. Low grade mineralization extracted by open pit mining methods from the Roby Zone was used during these tests. Testing occurred intermittently with mill modifications and repairs during 1991.

During the month of February, Madeleine Mines Ltd. was charged by the Ministry of the Environment with six counts under the Environmental Protection Act and the Ontario Water Resources Act. This case will be heard February 10, 1992 in Thunder Bay provincial offences court.

In October, Kaiser–Francis Oil of Oklahoma acquired 1.4 million common shares of Madeleine Mines Ltd. from Patrick Sheridan, thereby increasing its stake to 32%. Patrick Sheridan was replaced as President by Dale McDoulett of Kaiser–Francis Oil. Discussions with the Ministry of the Environment have taken place. Necessary permit applications could be approved by April 1992. In the meantime, testing of the mill will continue.

EXPLORATION ACTIVITY

Exploration activity in the Thunder Bay Resident Geologist's District declined in 1991. It also declined in the Thunder Bay Mining Division which includes the Beardmore–Geraldton and Schreiber–Hemlo Resident Geologist's districts. An indirect measure of this decline in the Thunder Bay Mining Division is the number of active claims. It has decreased from 31 202 to 28 054. The amount of assessment work received by the mining recorders office increased slightly, from $7 834 959 to $8 517 516. Changes to the Mining Act in the middle of the year make it difficult to use these numbers as a measure of the level of exploration activity. For example, 81% of the assessment work submitted was for work carried out in 1990 and prior, not 1991. In previous, more normal years, 50% of the assessment work submitted during the course of the year was actually carried out in years prior. Of the $8 517 516 of assessment work submitted this year, $6 792 366 was submitted prior to the implementation of the changes to the Mining Act on June 3. Old assessment work is being submitted to maintain properties on which little or no exploration activity is taking place.

In the Thunder Bay District the number of properties being explored has decreased from 89 to 64. This number underestimates the overall decrease in exploration activity as

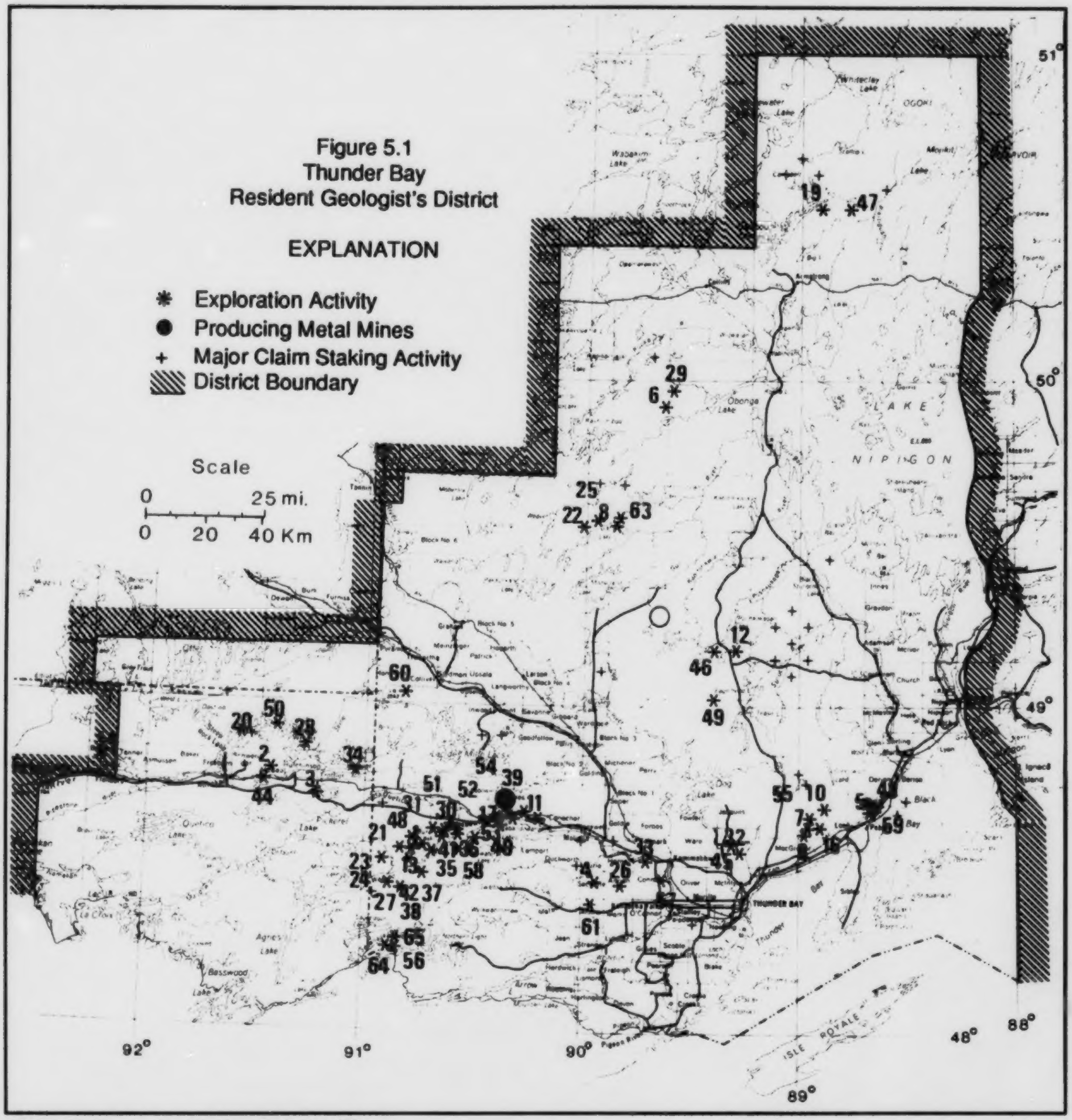


Figure 5.1
Thunder Bay
Resident Geologist's District
EXPLANATION
✱ Exploration Activity
● Producing Metal Mines
+ Major Claim Staking Activity
▨ District Boundary
Scale
0 25 mi.
0 20 40 Km
LAKE NIPIGON
THUNDER BAY
ISLE ROYALE
92°
91°
90°
89°
88°
48°
49°
50°
51°

Figure 5.1. Thunder Bay Resident Geologist's District.

it is not a measure of expenditures. Proportionately, the decrease in exploration expenditures is much greater because a greater proportion of properties were explored by prospectors with limited financial resources. In 1991, 47 properties were explored by prospectors (40 in 1990, 24 in 1989), 7 by junior mining companies (17 in 1990, 30 in 1989, 57 in 1988), and 11 by major mining companies (31 in 1990, 21 in 1989) (Table 5.1). The number of diamond drilling programs has decreased from 22 to 13, a good indicator of reduced expenditures. The number of OMIP grants has decreased from 15 to 10, reflecting the decrease in exploration activity by the junior mining sector. The number of OPAP grants has increased from 25 in 1990 to 40 in 1991.

The most sought after commodity is still gold. Gold was the primary target on 46 properties. Twelve properties were explored for base metals, 2 for platinum group metals (PGMs) and 7 for amethyst.

Without the benefit of a survey of expenditures, it is still possible to estimate that the level of mineral exploration in this district is near a 20 year low: no properties are undergoing advanced exploration; there were only two diamond drilling programs with over 1000 m of drilling and assessment work other than OPAP and OMIP performed and submitted this year, is near an all time low. Only $1 725 149 of assessment was submitted in the last seven months of 1991. For comparisons sake, this translates to $3 000 000 annually, or 166 000 man days.

The immediate, quite visible, effect is the decreased level of employment in the mineral exploration industry in the City of Thunder Bay. A large number of office closures in the City of Thunder Bay by mining companies and contractors have resulted in layoffs. Office closures this year include Mingold Resources Inc., Placer Dome Inc., Gold Fields Canadian Mining Ltd., Exploration Mimiska Inc., MCS Capital Ltd., and Noramco Exploration Inc. The remaining companies have reduced their workforce, for example, Noranda Exploration Company Ltd's Thunder Bay office had a payroll of 200 to 300 two years ago. It is now less than 30. Without the benefit of a survey, the authors estimate the reduction in exploration activities in northwestern Ontario has cost the City of Thunder Bay 500 high paying professional jobs and an exodus of highly skilled labour.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

The office of the Resident Geologist was staffed by M. Lavigne Jr., Resident Geologist and J. Scott, Geologist. Additional staff this year include; J. Bellinger, Data Geologist; M. Garland, Regional Mineral Specialist and K. Younger, Exhibition Designer. This office handled over 1300 inquiries, conducted 17 property visits, carried out reconnaissance in 4 areas and led 6 field trips. Five prospecting courses were conducted in this district; 2 in Thunder Bay, and 1 in Nipigon, Atikokan and Upsala. A total of 135 students participated. Instruction and course co-ordination involved staff from the Thunder Bay, Schreiber–Hemlo and Beardmore–Geraldton Districts, the Core Library, the Thunder Bay Mining Recorders office and the private sector.

Three special projects were initiated by this office. Each of these projects are staffed by specialists dedicated solely to their projects. J. Bellinger is creating a digital index of mineral exploration data superimposed onto digital topographic base maps using AutoCAD. NTS areas 52A and 52B have been completed (Bellinger 1991). M. Garland is documenting amethyst occurrences in the Thunder Bay area and will also generate a framework for realizing the growth potential of this industry (*see* Garland, this volume). K. Younger is developing a public education program which is raising awareness of the mining industry's importance in consultation with other organizations with a vested interest in the well being of the mining industry and with other special interest groups. Various media such as displays, literature, videos and educational kits are being developed for use in venues such as shopping centres, exhibitions and schools. A 20 m long prototype display consisting of 15, 1 by 2 m panels with photos, text, cartoons and graphics was constructed as a backdrop to numerous interactive elements, all of which are intent on demonstrating the mining sequence, and the importance of the mining industry to the general public. This display was used on 6 occasions, including Mining Week, with great success.

PROPERTY EXAMINATIONS

Fountain Lake Gold Discovery

During the fall of 1990, prospector John E. Ternowesky discovered more gold mineralization at the south end of the Moss Township property belonging to Fountain Lake Gold Ltd. This discovery is located 110 km west of Thunder Bay (*see* Figures 5.1 and 5.2). The property consists of a U shaped block consisting of 128 contiguous unpatented mining claims which extend from the southern shores of Moss Lake to Fountain Lake. The mineralization consists of 2 to 5% disseminated pyrite, minor galena and traces of sphalerite. Fifteen percent pyrite and galena also occur in millimetre wide seams parallel to schistosity. The host rock over the 10 m width of the mineralized zone is a sericite schist ranging in composition from almost pure, waxy and pale green sericite to a quartz-sericite schist with up to 60% quartz. Sulphide-rich zones are more siliceous. Grab samples collected by John E. Ternowesky over the 10 m width of this zone assayed 0.02 to 0.572 ounce Au per ton.

The zone of schistosity is 100 to 150 m in width, strikes at 45° and dips vertically. On the basis of an outcrop 50 m to the southwest, on strike with the mineralization, the protolith can be identified in a zone of weaker schistosity as felsic quartz-eye lapilli tuff. Felsic volcanic fragmentals are the dominant lithotypes in the immediate area with minor mafic volcanics. Alteration other than sericitization includes pervasive replacement by calcite, local replacement of feldspar by iron-carbonate, chloritization, and possible albitization.

This discovery is 4 km southwest of, and possibly on strike with, the previously discovered gold mineralization referred to as the Boundary Zone (*see* Figure 5.2). This zone straddles the Fountain Lake property and the Central Crude Limited–Tandem–Storimin property. The Boundary Zone may be the faulted extension of the QES Zone drilled by Central Crude Limited. The abundance of mineralized zones in this area (8 on this property) and the complexity of the controls on the distribution of gold mineralization precludes linking this new discovery with any previous discoveries. This new discovery is one of many gold occurrences in a broad, northeast-trending belt of schistose and hydrothermally altered rock with potential for many new discoveries.

Olcott Gold Prospect

The Olcott gold prospect, in McCaul Township east of Atikokan, was discovered in the early 1930s and has been

Table 5.1 Exploration activity in the Thunder Bay Resident Geologist's District.

Abbreviations

AEM	Airborne electromagnetic survey	IP	Induced polarization survey
AMag	Airborne magnetometer survey	Mag	Magnetometer survey
ARad	Airborne radiometric survey	Res	Resistivity survey
DDH	Diamond-drill hole	Rad	Radiometric survey
EM	Electromagnetic survey	UG	Underground work
HL-EM	Horizontal-loop electromagnetic survey	VLF	Very low frequency electromagnetic survey

Company/Individual (Property Name)	Claim Map Sheet (Commodity)	Exploration Activity
1) Akiko–Lori Gold Resources Ltd./ Omega Gold Corporation/ Gold Fields Canadian Mining	Moss Township (Au)	prospecting, sampling
2) Allegheny Mines Corporation (Atiko Mine)	McCaul Township (Au)	geology, geophysics, DDH
3) Andrews, M./Hicks, C. (Eva Lake Intrusion)	Eva Lake area (Pt, Pd, Cu, Ni, Co)	1 DDH (101')
4) Asarco Exploration Co of Canada Ltd.	Sackville and Adrian Townships (Cu, Zn)	line cutting, geophysics, geology
5) Bak, David	McTavish Township (amy)	stripping, trenching
6) BHP–Utah Mines Ltd.	Kashishibog and Whitebirch lakes areas (Cu, Zn)	AMag, EM, geology, DDH
7) Blue Star Resources Ltd.	McGregor Twp. (amy)	stripping
8) Bumbu, Costy	Garden Lake area (Au, Cu, Zn)	prospecting, trenching, line cutting
9) Chapman, S.F.	Haines Township (Au)	Mag, EM
10) Christianson, D.E./Mealey, L./Bond, J.	Tartan Lake area (Cu, Zn, Au)	line cutting, geochemistry
11) Christianson, Erik	Hagey and Conacher Townships (Au)	stripping, sampling, trenching
12) Egner, Matt/Curran, Mike	Max Lake area (Au, Cu, Zn)	sampling, prospecting
13) Fogen, M. (Jackfish Mine)	Moss Township (Au)	prospecting
14) Gliddon, Dave/Middaugh, Richard/Spence, W. Ian	Calm Lake area (Au)	prospecting
15) Gold Fields Canadian Mining	Burchell Lake area Tilly Lake area (Au)	VLF-EM, Mag, AEM
16) Grieve, Mike	Area North of MacGregor Township (amy)	manual trenching, blasting
17) Hackl, Joe	Haines Township (Au)	trenching, stripping, prospecting
18) Harty, R./Bruzzese, J.V.	Area North of MacGregor Township (amy)	manual stripping
19) INCO Exploration and Technical Services Inc.	Caribou Lake area (Ni, Cu, Zn)	reconnaissance
20) INCO Exploration and Technical Services Inc.	Finlayson Lake area (Cu, Zn)	reconnaissance
21) International Geoventures	Burchell Lake area (Au)	3 DDH 300 m
22) Kukkee, Edwin	Keams Lake area (Au)	sampling, prospecting
23) Kukkee, Ken	Moss Township (Au)	sampling
24) Kwiatkowski, Russell/Kukkee, Ken	Tilly Lake area, Powell Lake area (Au)	trenching
25) Kwiatkowski, Russell	Garden Lake area, Stonehouse Lake (Au)	sampling, prospecting
26) Laderoute, Dave/Murdy, Art	Adrian Township (Au, Cu, Zn)	geology, prospecting
27) Lariviere, J.	Powell Lake area (Au)	prospecting
28) Lavoie, Henri	Ramsay Wright Township (Au)	prospecting
29) Leishman, Don	Paddon Lake area (Ni, Cu, Pt)	reconnaissance geology, sampling
30) Lukosius-Sanders, Jurate (Cold Cash)	Burchell Lake area (Au)	prospecting, sampling, geology

Table 5.1 Continued.

Company/Individual (Property Name)	Claim Map Sheet (Commodity)	Exploration Activity
31) Lukosius-Sanders, Jurate	Ames and Moss Townships (Au)	prospecting, sampling, geology
32) Luski, Mike/Oja, Ray	Gorham Township (Au)	Mag
33) McAteer, W.	Dawson Road Lots (Au)	1 DDH
34) Noranda Exploration Company Ltd. (Bjorkman Option)	Hutchinson Township (Au)	geology, Mag
35) Noranda Exploration Company Ltd./ Central Crude Ltd./Broad Horizons, Inc.	Moss Township (Au)	3 DDH (721 m)
36) Noranda Exploration Company Ltd./ Freewest Resources Inc. (Coldstream Property)	Burchell Lake area (Au)	IP, DDH, (12 DDH - 2618 m)
37) Noranda Exploration Company Ltd./ Challenger Minerals Ltd. (Deaty's Creek)	Moss Township (Au)	geology, prospecting, Mag, IP, 4 DDH (499 m)
38) Noranda Exploration Company Ltd./ Grand Portage Resources Ltd.	Moss Township (Au)	geology, prospecting, trenching, Mag, IP, HL-EM, 3 DDH (879 m)
39) Noranda Exploration Company Ltd. (Kabaigon)	Hagey Township (Au)	lithogeochemistry, prospecting
40) Noranda Exploration Company Ltd. (Vanguard Occurrence)	Kashabowie Lake area (Cu, Zn)	HL-EM, pulse EM, 3 DDH (920 m)
41) Noranda Exploration Company Ltd. (West Burchell)	Burchell Lake area (Au)	geology, prospecting, trenching
42) Noranda Exploration Company Ltd. (Windblown)	Moss Township (Au)	geology, prospecting, lithogeochemistry, sampling, trenching
43) Noyes, Douglas	McTavish Township (amy)	stripping
44) Petrunka, David	McCaul Township (Au)	geology, sampling
45) Pitkanen, Ray	Gorham Township (Au)	prospecting
46) Purdon, Robert/Puumala, Allan	Max Lake area (Au)	prospecting
47) Randa, Ty	Linklater Lake area (Cu, Zn)	prospecting
48) Ranta, Eino	Moss Township (Au)	prospecting
49) Richmond, Bill/Morehouse, William	Smiley Lake area (Cu, Zn, Au)	sampling, prospecting
50) Sande, D./Stewart, T. (Lynxhead Bay)	Marmion Lake area (Au)	stripping, sampling, prospecting
51) Sanders, Todd (East Coldstream)	Burchell Lake area (Au)	prospecting
52) Sanders, Todd (Shebandowan West)	Burchell Lake area (Au)	prospecting, line cutting, geology
53) Sanders, Todd	Greenwater Lake area (Au)	prospecting
54) Schoor, Manfred	Haines Township (Au)	stripping, trenching
55) Siltamaki, Aki	North of MacGregor Township (amy)	manual trenching, prospecting
56) Starr, Eugene	Saganagons Lake area (Au)	prospecting
57) Stewardson, Matt	Conmee Township (Au, Mo)	manual mechanical, stripping, Mag, VLF-EM
58) Tweedie, Ron	Burchell Lake area (Au)	geology, prospecting
59) Twomey, Tim	McTavish Township (amy)	prospecting, sampling
60) Vibert, James	Hanniwell Township (Au)	stripping, sampling, trenching, geophysics
61) Wallace, Arthur/Wing Allan/Calvert Dan	Aldina Township (Au)	prospecting
62) Weaver Lake Resources	Garden Lake area (Cu, Zn)	line cutting, geophysics
63) Wye Resources	Gorham Township (Ni, Cu, Pt)	1 DDH
64) Wye Resources (Powell)	Saganaga Lake area (Au)	DDH, prospecting
65) Yu, Richard	Saganaga Lake area (Au)	geology

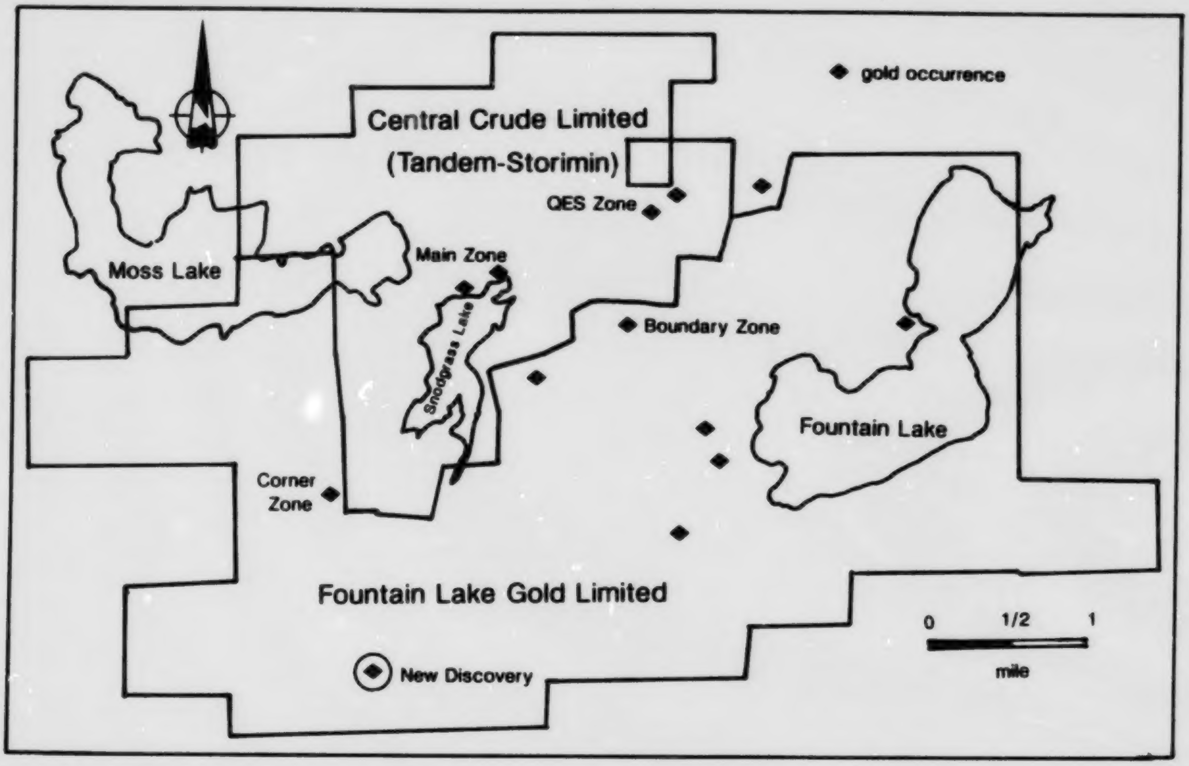


Figure 5.2. Gold occurrences in the Fountain Lake–Moss Lake area.

subjected to a reasonable amount of scrutiny ever since. Extensive stripping in 1990 by co-owner Wayne McChristie and detailed sampling in 1991 by co-owner Dave Petrunka has revealed the complex nature of the gold-bearing structure and gold distribution.

As currently exposed by a 100 m by 40 m stripped area, this occurrence consists of a central quartz vein up to 3 m in width which extends beyond the length of the stripped area. The vein is enveloped by strong iron-carbonate alteration, 25 m in width. This alteration zone contains pyrite and arsenopyrite.

The overall strike direction of the vein is 130°. The vein and the alteration are affected by a well-developed foliation which strikes at 80° and numerous shear zones which strike from 0° to 40°. The net result is a tightly folded vein with numerous sharp offsets. Structural elements which controlled the emplacement of the vein were not observed as they were most likely destroyed by the latest deformation. Under these conditions, predicting the direction of the continuity of this vein would be difficult, the numerous unsuccessful diamond drilling programs carried out on this property to date attest to this.

The alteration zone adds an element of predictability in tracing out this mineralized system. A high percentage of magnetite was observed along the outside edge of the alteration zone. If this magnetite alteration is persistent, the magnetic highs on either side of the magnetite destructive iron-carbonate alteration (magnetic low), should be easy to trace out with a detailed magnetometer survey.

D. Petrunka carried out a blasting and sampling program on this property in 1991. Several trenches on the main zone were sampled. Thirty-eight samples were taken from a north-trending 7 m long trench at the eastern limit of the exposure. At this location the zone is severely affected by north-trending shearing which has produced carbonate-mica schist with disseminated pyrite and arsenopyrite. The average value from these samples is 0.187 ounce Au per ton, the lowest value being 0.033 and the highest 0.563 ounce Au per ton. Much of the material sampled was quartz-vein free. At the west end of the exposure, at two separate locations, mineralized, quartz-vein free wallrock assayed 0.243 ounce Au per ton (average of 3) and 0.033 ounce Au per ton (average of 5).

In summary, the two-dimensional information gained by overburden removal has demonstrated why numerous diamond drilling programs failed to trace out this gold mineralization. A better grasp of the structural controls and the nature of the mineralization provided by this new exposure will lead to an expansion of this gold occurrence.

Eva Lake Intrusion

In 1979, J. Essary, local cottage owner brought a sulphide-rich sample to the attention of the Noranda Exploration

Company Limited. This sample assayed 1.42% Cu, 1.48% Ni, 0.037 ounce Au per ton, and 0.003 ounce Ag per ton. This sample was collected from a 15 m wide gossan 40 m west of Highway 633 where it meets with the western shore of Eva Lake. Noranda confirmed this assay with 43 feet of channel samples and also carried out a magnetometer and MaxMin EM surveys (Resident Geologist's files, Thunder Bay District, Thunder Bay). The property was subsequently dropped. In 1986 Ministry of Northern Development and Mines staff collected four grab samples from this occurrence. One of these samples assayed 630 ppb Pt, 760 ppb Pd, 730 ppb Au and 210 ppm Co. Samples collected in 1991 produced similar values.

This property is currently staked by M. Andrews who is working in partnership with C. Hicks. In August they drilled one 101 foot hole and assayed 52 samples for Pt, Pd, Au, Cu, Ni, Co, and Cr. The highest values, all in two foot lengths of core are; 390 ppb Pt, 195 ppb Pd, 227 ppb Au, 9439 ppm Cu, 5220 ppm Ni, 200 ppm Co, and 664 ppm Cr.

The mineralization consist of 1 to 5% finely disseminated to coarse blebs of pyrrhotite and chalcopyrite. The host rock is a variably altered pyroxenite with abundant and variable amounts of biotite, talc and actinolite.

Whistle Lake–Wabikon Lake Area

LOCATION AND ACCESS

The Whistle Lake–Wabikon Lake area is situated approximately 115 km north of Thunder Bay just south of the Highway 527–Highway 811 intersection. The area of interest is located between this intersection and the Whistle Lake Road–Highway 527 intersection 7 km to the south. Numerous old logging roads, some of which have partially grown in, transect the area and provide good access to most parts of the area.

PREVIOUS WORK

Milne (1964) and Sage et al. (1974) mapped the area for the Ontario Geological Survey at a reconnaissance scale. Mineral exploration companies showed interest in the area during the initial Highway 527 (Spruce River Road) construction phase in the early and mid-1960s. Exploration activity was strong throughout the 1970s, waned a little in the 1980s and appears to have increased again in the late 1980s early 1990s. Although assessment work reports are available at the Thunder Bay Resident Geologist's office and should be consulted, the following is a chronology of work done:

1874: Garden surveyed an exploratory line for the Canadian Pacific Railway which passed through the central portion of the area.

1922: Phillips and Benner, OLS, surveyed several base and meridian lines in the area southwest and west of Nipigon.

1923: W.L. Swanson, noted the geology along the Phillips and Benner baselines for the Ontario Department of Mines.

1930: Ontario Department of Lands and Forests constructed a base and prospecting was carried out in the area.

1934: F. Jolliffe mapped the "Block Creek Area" for the Canada Department of Mines, Geological Survey.

1960: N.H. Black described the geology of the Whistle Lake area and of the Block Creek–Black Sturgeon area in a report for the Canadian Pacific Railway.

1962: V.G. Milne (1964) mapped the Garden Lake area that included a portion of Whistle Lake–Wabikon Lake area.

1965: Steep Rock Iron Mines Ltd. conducted mineral exploration on the Armstrong Option.

1970: Phelps Dodge Corporation of Canada Ltd. optioned the Adams Property; five diamond-drill holes were drilled.

1975: Phelps Dodge Corporation of Canada Ltd.; diamond drilling.

1973: Mineral Resources International Ltd.; diamond drilling.

1973: Sage et al. (1974) conducted a helicopter assisted reconnaissance geological survey of a large area north of Thunder Bay that included the Whistle Lake–Wabikon Lake area.

1975: Hanna Mining acquired property in the Lever Lake area. Electromagnetic and magnetometer surveys were conducted and 4 diamond-drill holes were drilled.

Hanna also explored near Whistle Lake where in addition to electromagnetic and magnetometer surveys, 4 diamond-drill holes were drilled.

1980: Amoco Canada Petroleum Co. Ltd. drilled 3 diamond-drill holes in the Whistle Lake area.

1988–

1990: Cumberland Resources Ltd. acquired ground in the Whistle Lake–Lever Lake area and conducted airborne electromagnetic, very low frequency and magnetometer surveys.

Mingold Resources Ltd. optioned the Nault Lake property from B. Hayne and drilled 6 diamond-drill holes.

GENERAL GEOLOGY

Although aspects of the Whistle Lake area geology has been described by various authors, the area has not undergone systematic detail mapping. The detailed mapping that has been done is limited to exploration grids. The following geological description is summarized from available sources; most of which is from Sage et al. (1974).

The Whistle Lake belt is an easterly trending belt of volcanic and sedimentary rocks of varying width with an exposed strike length of over 70 km. West of Chisamore Lake the volcanic rocks strike under extensive Quaternary cover associated with the Kaiashk Moraine. Towards the east, the belt strikes under Mesoproterozoic rocks of the Sibley Group. Within these limits, extensive logging and forest fires have exposed considerable outcrop throughout the area.

Sage et al. (1974) located a previously unmapped felsic metavolcanic unit of rhyodacite to rhyolite composition. This unit is exposed along a logging road just north of McLay Lake and locally contains disseminated pyrite. An intermediate to felsic volcanic pyroclastic breccia unit of probable dacitic composition exists about 0.4 km northwest of an unnamed lake approximately 2.4 km southwest of Whitton Lake. To the north this pyroclastic unit is in contact with a banded chert-carbonate horizon that appears to be in excess of 15 m wide. Silicification is apparent in some areas within this chert-carbonate unit.

A good cross section of the belt can be examined in road cuts along Highway 527. At the southern end of the long straight stretch south of Abitibi Price Camp 230, a hornblende monzonite intrusion is in sharp contact with a banded amphibolite. This amphibolite is greater than 120 m thick and is in contact to the south with felsic tuffs and agglomerates that are 0.8 km thick. These felsic volcanics are separated from the mafic volcanics to the south by a massive quartz-feldspar porphyry intrusion that is exposed all the way to the Whistle Lake access road. Mafic volcanics interdigitate with this felsic porphyry unit south of the Whistle Lake road. Further to the south the porphyry is in contact with more equigranular trondhjemitic to granodiorite rocks.

Sage et al. (1974) indicate that the felsic metavolcanic rocks of the Whistle Lake area are rhyodacite to dacite in composition. The felsic units to the west near McLay Lake are probably the same horizon. This felsic volcanic horizon averages about 0.8 km wide and is at least 16 km long. Overlying Keweenawan diabase sills makes tracing this unit difficult. Disseminated to massive sulphide mineralization is associated with this felsic volcanic unit. A massive sulphide lens, situated just northeast of Whistle Lake, is about 15 m thick and is traceable for over 60 m along strike. This sulphide zone is situated between a felsic volcanic tuff to the south and a banded chert carbonate unit to the north. Diamond drilling by Mineral Resources International Ltd. in 1973 encountered low copper values.

Volcanic rocks other than felsic in composition include massive mafic to intermediate flows and pillowed flows. Spinifex textures have been reported by Sage et al. (1974) north of Whistle Lake in a mafic flow unit. Lapilli tuff of probable felsic composition exists at the Lever Lake narrows.

Keweenawan diabase, as outliers of sills probably cover about 40% of the area making interpretation of the Mesoarchean geology difficult.

ECONOMIC GEOLOGY

Mineral exploration in the Whistle Lake area became more attractive upon the completion of the Spruce River Road now Highway 527, in the late 1960s.

Numerous occurrences of disseminated sulphides and local occurrences of massive sulphide mineralization associated with felsic volcanic pyroclastics would suggest the area should be thoroughly examined for base metals. Copper values of up to 0.11%, over 5 feet (Hole 150-1) and Zn values of up to 0.76% over 10 feet (Hole 150-2) were encountered in drilling by Phelps Dodge in 1975 (Resident Geologist's files, Thunder Bay District, Thunder Bay).

A zone of copper mineralization was sampled on Cumberland Resources property and was assayed for Cu and Au. Analysis of the grab samples shows 0.349 ounce Au per ton and 0.768% Cu. Additional copper results were as high as 1.4%. This zone is hosted by altered felsic volcanic tuffs and is located approximately 100 m east of Highway 527 from the first rock cut north of a small creek that flows into Dubroy Lake from Nault Lake. The copper mineralization at this locality consists of bornite, chalcopyrite and malachite. No visible gold was seen. An undetermined grey alteration plus sericite dominates the mineralized zone. Minor zinc values are also associated with this zone. The mineralized section is exposed on the south facing slope of a small outcrop area consisting of pink to buff weathering felsic tuffs. Low ground to the south plus low ground along strike hampers the dimensional assessment of the occurrence.

Approximately 1.25 km south of the above location on Highway 527, a sulphide zone is exposed on the east side of the highway. Massive to disseminated pyrite, fine aggregates of chalcopyrite plus areas stained by rust are apparent on the outcrop. The host rock is an intermediate to mafic volcanic flow. Samples from this locality were analysed for Au and Cu with the following results: sample JFS-83-91 assayed 0.89% Cu and 16 000 ppb Au; sample JFS-84-91 assayed 0.865% Cu and 15 000 ppb Au. This property is currently held by B. Hayne of Thunder Bay.

GARDEN LAKE AREA

A reconnaissance-type geological survey of a road system north of Garden Lake (lat. 49°32'N, long. 89°48W') was undertaken in the summer of 1991 to delineate a zone of sulphide mineralization that transects the area. This zone was first discovered by Phelan (1947) and Stocking (1962).

Logging by Abitibi Price Inc. has exposed enough rock outcrops along the zone to allow the mapping of the sulphide zone and adjacent rocks with some degree of certainty with respect to location.

The property and road system is situated between the old Lands and Forest Fire Tower and Garden Lake. Access to the property is via the Grew River Road; the property is situated approximately 10 km southwest of the Highway 811–Grew River Road intersection. Logging roads south of the Grew River Road access the sulphide zone.

GEOLOGY

The bedrock geology as exposed on the road system is dominated by mafic to intermediate, massive to pillowed flows, pillow breccias and volcanic breccias. Most top indicators have been obliterated by tectonics and/or metamorphism, but the few preserved pillowed outcrops suggest that the sequence faces north. Felsic volcanic rocks are exposed north of the sulphide zone near its western exposure. Current mapping suggests that the felsic component of the belt in the area mapped is minor. The volcanics are generally east trending.

Alteration associated with the sulphide zone consists of intense silicification, garnets and anthophyllite. Garnet alteration is best exposed in the western section near the west access road (Figure 5.3). Silica flooding may be confused with banded chert. The former is also exposed on the west access road proximal to the garnet alteration; the banded chert is exposed on several rocky knolls just east of the garnet altered rock. Presumably the cherts sit on top of the sulphide zone. The anthophyllite alteration is exposed in the eastern trenches along the logging road that accesses the sulphide zone.

A granodiorite to trondhjemite intrusion is situated south of the volcanic rocks and north of the western end of Garden Lake. This unit weathers chalky white and for the most part is medium grained. Small scale shears at about 295° are common. Epidote alteration is pervasive on some outcrops. Regional mapping by Milne (1964) indicates that this granitoid is a sliver projecting from the main batholith to the north into the main volcanic belt.

The high hill north of the sulphide zone is a Keweenawan diabase sill outlier.

ECONOMIC GEOLOGY

Samples taken were analyzed for base metals and gold the results are shown in Table 5.2. Samples prefixed CB were collected by Costy Bumbu, prospector, who owns the claims; samples prefixed JFS were collected by the co-author. Except

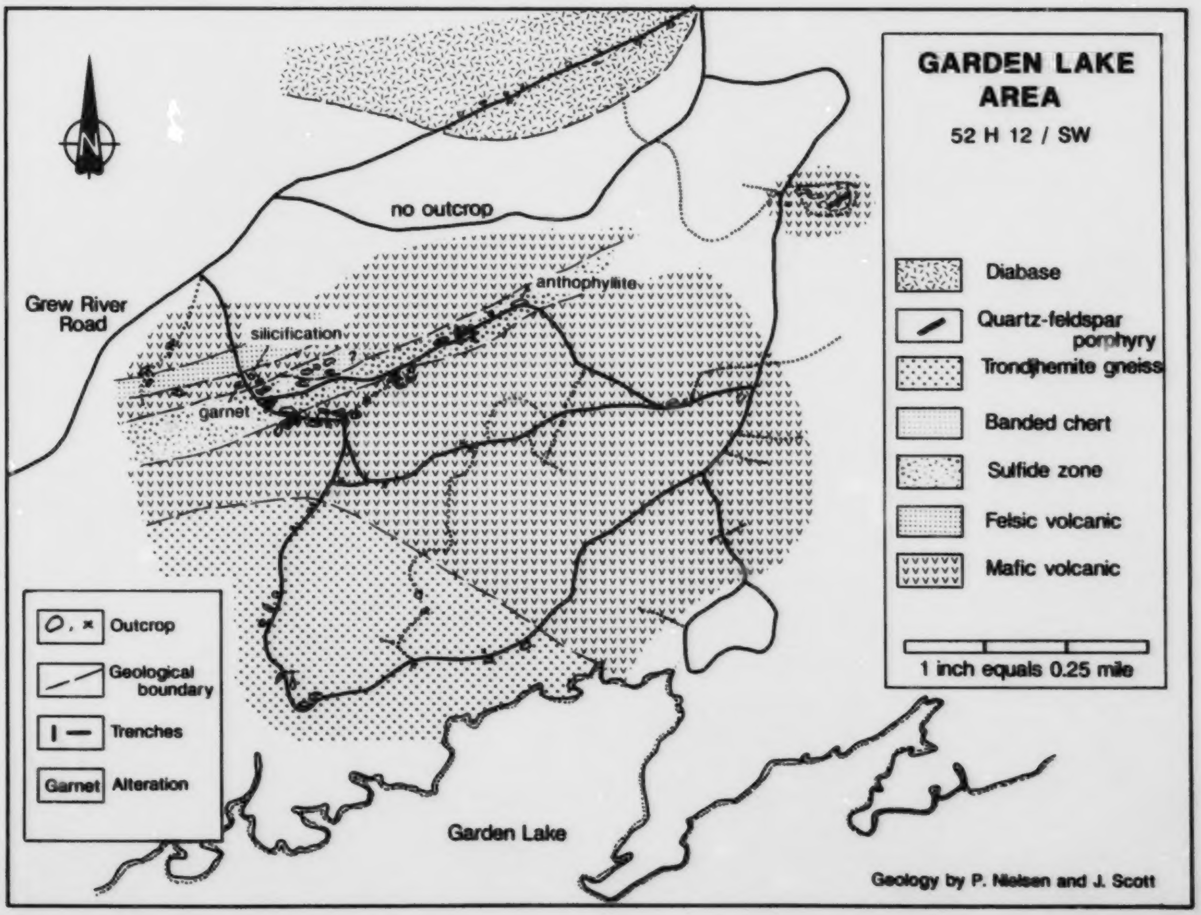

GARDEN LAKE
AREA
52 H 12 / SW
N
no outcrop
Grew River Road
anthophyllite
silicification
garnet
Diabase
Quartz-feldspar porphyry
Trondhjemite gneiss
Banded chert
Sulfide zone
Felsic volcanic
Mafic volcanic
1 inch equals 0.25 mile
O, × Outcrop
Geological boundary
Trenches
Garnet Alteration
Garden Lake
Geology by P. Nielsen and J. Scott

Figure 5.3. Garden Lake area.

Table 5.2. Selected assays, Garden Lake area.

Sample Number	Au ppb	Ag ppm	Cu ppm	Zn ppm	Pb ppm	Co ppm
JFS- 35-91	4	n/a	135	29	<10	n/a
JFS- 63-91	150					
JFS- 98-91	3	n/a	185	138	<10	n/a
JFS- 99-91	7	n/a	340	138	<10	n/a
JFS-100-91	5	n/a	375	85	<10	n/a
JFS-104-91	0.024 oz/t	Tr.	200	44	<10	264
JFS-105-91	0.004 oz/t	Tr.	440	76	<10	244
JFS-106-91	nil	nil	196	64	<10	176
CB-1	468	28	6.11%	983	n/a	550
CB-2	<5	<5	240	95	n/a	96
CB-3	<5	<5	260	50	n/a	35

for sample CB-1, all the samples reflect background values for the base metals. Diligent prospecting, perhaps along strike, might reveal higher concentrations of base metals. Sample CB-1 was collected from trench 1 (*see* Figure 5.3).

The sulphide zone is composed of pyrite in massive lenses to disseminated aggregates. The weathered surface is rusty and in some places a gossan cap covers the sulphide zone. Sulphide-rich float is prevalent in the drift cover down ice from the zone.

Although the majority of the assay results are subeconomic, they appear to be weakly anomalous in copper. Diligent evaluation of the property, especially recently delineated geophysical anomalies located by an Aerodat survey for Garden Lake Resources Ltd. (Resident Geologist's Files, Thunder Bay District, Thunder Bay), could possibly result in the finding of economic values in base metals. These anomalies were not evaluated by Garden Lake Resources Ltd.

Other Areas–Significant Assays

Several properties were sampled during the past summer and assay results indicate that their potential for gold and/or base metals is quite good. Some of these properties are semidormant; others are relatively new and deserve work; some have been optioned; all of them are worthy of exploration. Newer occurrences in a generally overlooked area (Highway 527) opens great potential for mineral exploration north of Thunder Bay.

Table 5.3 illustrates some of the significant assay results obtained this year. Samples JFS-41-91 to JFS-47-91 represent continuous chip samples of 4.83 m. The property is the Dawson Road Lots–West Trenches occurrence located in the Dawson Road Lots. The reader is referred to Figure 5.4 in Lavigne et al. (1990) for location of the western trench.

Sheared quartz-carbonate veins associated with rusty, lean iron formation, 400 m northwest of Geddes Lake (lat. 490°8N', long. 89°20'W; 52 H/3, Max Lake area) were sampled for gold. The property was originally discovered by Canamax Resources Inc. Currently the property is owned by M. Egner and M. Curran. Grab samples were assayed for gold and the results are tabulated in the chart for samples JFS-74-91 to JFS-79-91. An inspection of the Canamax core from Hole D-X23, stored at the Thunder Bay Drill Core Library, revealed a zinc-rich portion that was overlooked and not split by Canamax. Assays of over 10 000 ppm Zn are reported by Egner and Curran (1990) from this section.

Trenches east of the North Coldstream Mine at Burchell Lake (lat. 48°35'N, long. 90°38'W) were sampled for gold. Silicified, mineralized volcanic rocks hosted good gold values. These are tabulated as JFS-85-91 to JFS-91-91. This property is currently under option to Noranda Exploration Company Limited.

Shebandowan Narrows

Mr. Joe Hackl of Shebandowan, Ontario, discovered gold mineralization associated with sheared and carbonate-altered zones in rock described by Hodgkinson (1968) as being a biotite granite–biotite syenite. Quartz veinlets with pyrite abound in the gold bearing zones. This granitoid intrusive is exposed as a high ridge on the eastern peninsula at the Shebandowan Narrows (Figure 5.4).

Access to the property is by boat from various launch sites on Shebandowan Lake. A series of samples from blasted areas were analyzed for Au, Cu and Zn. The results are shown in Table 5.4.

The B-zone is located 100 m north of a small bay that is situated about 700 m east of the narrows between Upper and Middle Shebandowan Lakes. The zinc-zone is situated about 150 m south of the east end of the east bay at the narrows.

The Portage zone is situated near the portage between Upper and Middle Shebandowan lakes and is located near the narrow portion of the peninsula in central Haines Township (*see* Figure 5.4). The zinc values were obtained from sphalerite-carbonate zones in sheared volcanic rocks.

Mr. Hackl has recently optioned his new gold discovery to Teck Corporation.

HACKL'S HAINES TOWNSHIP COPPER-NICKEL OCCURRENCE

Mr. Hackl also acquired ground to the southeast of the gold discovery north of the Crayfish Creek Fault as depicted on Map 2128 (Hodgkinson 1968). Here old trenches have been sampled by Mr. Hackl. The results submitted by Mr. Hackl are shown in Table 5.5.

Sample sites A to E are situated 200 m east of the eastern end of Upper Shebandowan Lake and are strung in a southerly line from that point for about 1.3 km. Samples F to I were from the eastern side of a small broad peninsula located on the south shore of Middle Shebandowan Lake south of Kabaigon Island (*see* Figure 5.4). Some of these occurrences comprised what is known as the "Milkie Occurrence". Mr. Hackl plans to further evaluate these occurrences this field season.

THUNDER BAY DRILL CORE LIBRARY

Introduction

The Thunder Bay Drill Core Library is 1 of 7 core libraries across Ontario operated by the Ministry of Northern Development and Mines. Collectively, they promote and support Ontario's minerals industry by preserving drill core of economic, academic and historical importance.

In 1991, the Thunder Bay Drill Core Library was staffed by P. Sarvas (Drill Core Library Geologist), B. Nelson (Assistant Drill Core Library Geologist), D. McKay (Assistant Drill Core Library Geologist, January) and L. Murray (Receptionist, January to March). Staff activities were supervised by M. Lavigne Jr., the Thunder Bay Resident Geologist.

The Thunder Bay Drill Core Library collects drill core from the Thunder Bay Mining Division, which encompasses 3 Resident Geologists' districts: Thunder Bay, Beardmore–Geraldton and Schreiber–Hemlo (*see also* Figure 5.1; 6.1 and 7.1 this volume).

Drill Core Inventory

During the summer of 1991, a comprehensive inventory of stored drill core was completed. It indicated that there are 112 062 m of drill core available for examination at the Thunder Bay Drill Core Library.

This includes: 43 092 m from the Thunder Bay Resident Geologist District; 31 391 m from the Beardmore–Geraldton Resident Geologist District and 37 579 m from the Schreiber–Hemlo Resident Geologist District. Most of the drill core was produced by exploration programs searching for metallic mineral deposits. The majority of these were dedicated to the search for gold (Figure 5.5 and Table 5.6). Table 5.7 lists drill core collected and stored between December 1, 1990 and November 30, 1991.

Catalogues

All of Ontario's core libraries print and distribute a drill core library catalogue. This catalogue is an up-to-date tabular listing of drill core stored at that core library. Information such as company, location, hole number, year of drilling, depth and available analytical data is presented in columnar form (Figure 5.6). Catalogues are available free of charge; just contact any Core Library or Resident Geologist's office.

Analysis of Drill Core

The analysis and sectioning of drill core stored at the Thunder Bay Drill Core Library is allowed at the discretion of Drill Core Library staff. Terms and conditions are:

A. Assays (and other destructive tests):

- costs of all assays, tests and shipments of samples will be borne by the client.
- assays and/or test results will be released to the client and the core library at the same time.
- the assays and/or test results may be kept "confidential" for up to three (3) months from the time of sampling if the client requests. The results will then be released to the general public.
- pulps and rejects must be returned to the Drill Core Library.

B. Sectioning (and other non-destructive tests):

- costs of all sections, tests and shipment of samples will be borne by the client.
- sections and/or test results will be the property of the Drill Core Library. The sections and/or test results may be kept "confidential" for up to three (3) months if the client requests. The sections and/or results will then be released to the general public.
- sections are to be examined at the Drill Core Library.
- cut-off and remaining samples are to be returned to the Drill Core Library.

Transmitting light and reflected light microscopes are available at the Drill Core Library for examination of sections.

Table 5.3 Significant assays 1991.

Sample Number	Au ppb	Ag ppm	Cu ppm	Zn ppm	Pb ppm	Ni ppm	Mo ppm	Pt/Pd ppb	Remarks
JFS- 1-91	0.004 g/t		0.524%						Rinker Lake quartz-carbonate vein (Map 2136)
JFS- 8-91	0.037 g/t								Vande Lake, iron formation (M2172)
JFS-17A-91	<2	<2	240	0.2425					Garden Lake, sulphur-rich float (R. Kwiatkowski)
JFS-18-91	0.017 g/t	0.35	0.248%	12.32%	1.628%				Altered felsic volcanic, Lumby Lake (P.2828)
JFS-19-91	Tr	Tr	412	0.1416%	84				Hanniwell Township, Zinc zone (J. Vibert)
JFS-21-91	12	<2	96	1080	<10				Holinshead Lake, sulphur-rich float (B. Hendry)
JFS-23-91	50	3	0.27%	680	21/25				Upsala area, chalcopyrite in mafic rock and biotite schist and malachite (M. Schoor)
JFS-24-91	80	6	0.36%						
JFS-30-91	0.037oz/t	Tr	0.2196%						West of Hanniwell Township (L. Chapman)
JFS-38-91	0.004 oz/t	Nil	7840						Quartz-vein material with
JFS-39-91	0.006 oz/t	Nil	5280						chalcopyrite, pyrite, Hanniwell Township (L. Chapman)
JFS-40-91	Tr		3024						Sibley Group stromatolite, chalcocite malachite Disraeli Lake
JFS-41-91 (1 m)	120	<2	29	150	<10				Chip samples across West
JFS-41-91 (.23 m)	1220	<2	163	115	33				trench at Bylund west occurrence
JFS-43-91 (.7 m)	85	<2	30	89	<10				Dawson Road Lots. Continuous across
JFS-44-91 (.6 m)	1600	<2	44	77	<10	4.83 m			
JFS-45-91 (.5 m)	16000	<2	335	275	<10				
JFS-46-91 (1 m)	8500	<2	150	208	<10				
JFS-47-91 (.8 m)	1765	<2	22	140	<10				
JFS-55-91	<2	<2	86000	30					Proterozoic Pb-Zn
JFS-56-91	3	11	163	24400					vein (J. Bruzzese)
JFS-57-91	<2	4	375	11600					
JFS-61-91	15	2326							Young–Walsh property, Conmee Township
JFS-54-91	220	21000	18						Shebandowan area (J. Hackl)
JFS-65-91	1030	19	8						Grab samples,
JFS-66-91	1100	10	13						Shebandowan area
JFS-67-91	2260	9200	28						Haines Township
JFS-68-91	8000	19	8						
JFS-69-91	50	71	16000						
JFS-70-91	39	8	47						
JFS-71-91	93	48	22000						
JFS-72-91	545	8400	67						
JFS-73-91	235	23000	57						Whalen occurrence, Lake Shebandowan

Table 5.3 Continued.

Sample Number	Au ppb	Ag ppm	Cu ppm	Zn ppm	Pb ppm	Ni ppm	Mo ppm	Pt/Pd ppb	Remarks
JFS-74-91	147	<2	88						Geddes Lake area
JFS-75-91	450								sheared quartz-carbonate
JFS-76-91	1650								veins in iron
JFS-77-91	20								formation
JFS-78-91	1600								(Map 2136)
JFS-79-91	750								
JFS-83-91	16000	8900							Highway 527 at 87 km,
JFS-84-91	15000	8650							chalcopyrite, pyrite, in volcanics (B. Hayne)
JFS-85-91	3600								North Coldstream
JFS-86-91	4600								property -
JFS-87-91	3300								Burchell Lake
JFS-88-91	5200								
JFS-89-91	4600								
JFS-90-91	3400								
JFS-91-91	4750								
JFS-107-91	0.349 oz/t	7680	296						Altered felsic
JFS-111-91	3200								tuff south of
JFS-112-91	14100								Wabikon Lake, chalcopyrite, bornite, malachite (Cumberland Resources)
JFS-131-91	0.609 oz/t	3.77 oz/t							Moss Mine area, Noranda trench

Donation of Drill Core

In June of 1991, section 82 of the Mining Amendment Act, 1989 came into effect, introducing a new set of regulations that govern mining exploration activities in Ontario. Among these are regulations that describe conditions for donation of drill core to Ontario's core libraries. The relevant sections of the Mining Act Regulations are:

Section 16(9): A holder of a mining claim who performs a program of diamond drilling or overburden drilling on it is eligible for an assessment work credit, in addition to that claimed elsewhere under this section, of 4 per cent of the cost of the drilling program if the appropriate Resident Geologist is advised that the holder does not wish to retain the core and samples.

Section 16(10): The holder of the mining claim shall,

(a) dispose of the core and samples in an appropriate manner under the conditions of the holder's work permit issued under the Public Lands Act or the Forest Fire Prevention Act; or

(b) if clause (a) does not apply and the Resident Geologist so requests, deliver the core and samples at the holder's sole expense to the nearest core library or to another location designated by the Resident Geologist.

RECOMMENDATIONS FOR EXPLORATION

Cobalt

INTRODUCTION

The gradual rise in the price of cobalt from a $6 to $7 (US) per pound range in 1988–89 to the $15 range in 1990–91 to the recent rapid rise in the free market value of cobalt almost reaching $30 is reason to reassess the economics of many of our mineral deposits and mineral exploration strategies. The Thunder Bay District is particularly well endowed with cobalt prospects and the following are descriptions of situations which themselves are good targets, but also provide some insight on the geological environments that are enriched in cobalt.

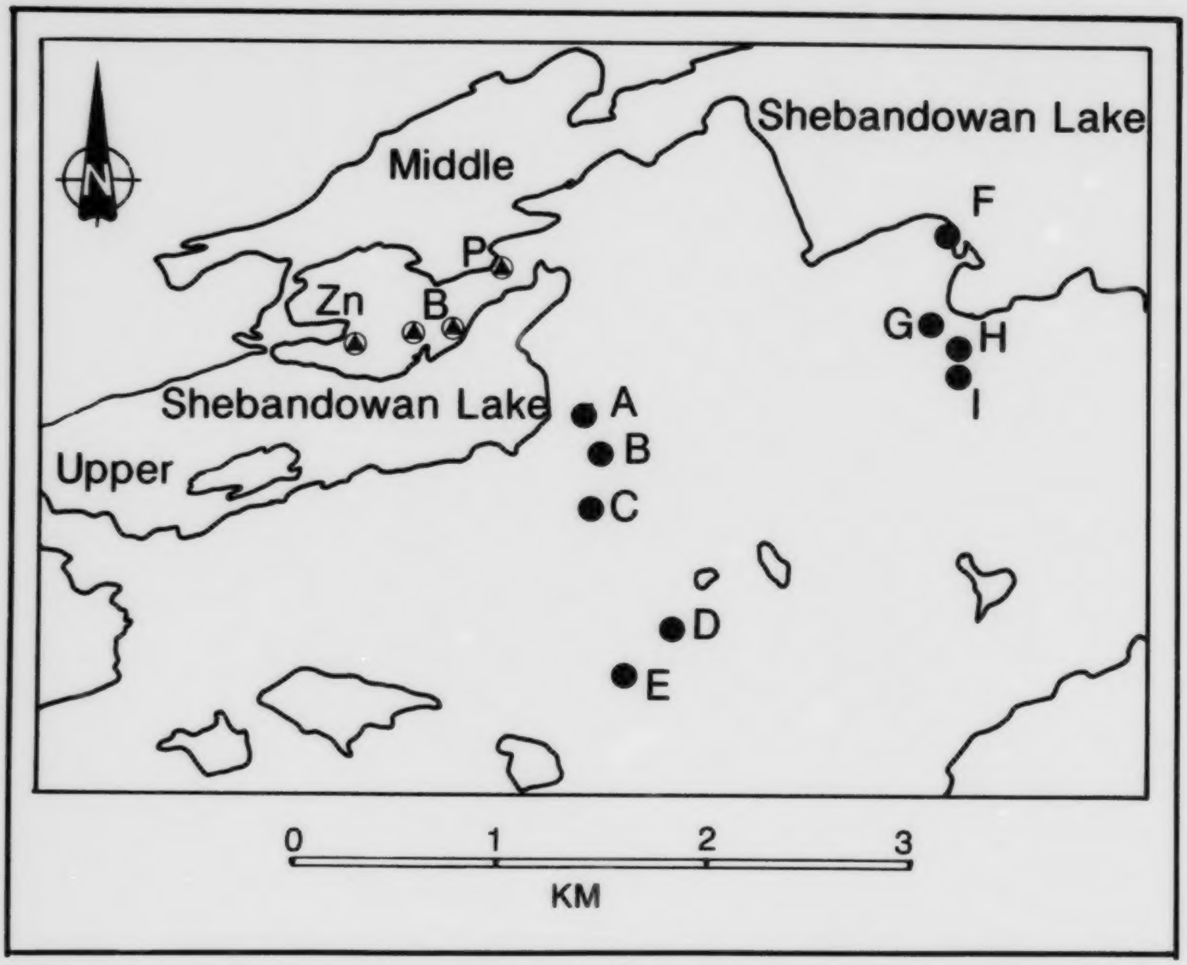

N
Middle
Shebandowan Lake
Shebandowan Lake
Upper
P
Zn
B
A
B
C
D
E
F
G
H
I
0
1
2
3
KM

Figure 5.4. Shebandowan Narrows gold and base metal occurrences.

Table 5.4. Shebandowan Narrows gold occurrence assays.

Sample Number	Au ppb	Cu ppm	Zn ppm	Remarks
JFS-65-91	1030	19	8	B-zone
JFS-66-91	1100	10	13	B-zone
JFS-67-91	2260	9200	28	B-zone
JFS-68-91	8000	19	8	B-zone
JFS-69-91	50	71	16000	Zinc zone
JFS-70-91	39	8	47	Zinc zone
JFS-71-91	93	48	22000	Zinc zone
JFS-72-91	545	8400	67	Portage zone

Table 5.5. Hackle's–Haines Township copper-nickel occurrence assays.

Sample Number	Cu %	Ni %	Zn %	Au
A-Zone	2.20	2.83	—	—
B-Zone	3.81	1.77	.20	—
C-Zone	3.88	—	—	1.26 g/t
D-Zone	9.67	—	—	3.64 g/t
E-Zone	2.06	1.10	—	17553 ppb
F-Zone	—	—	—	370 ppb
G-Zone	—	—	—	—
H-Zone	0.48	—	—	—
I-Zone	0.53	—	—	904 ppb

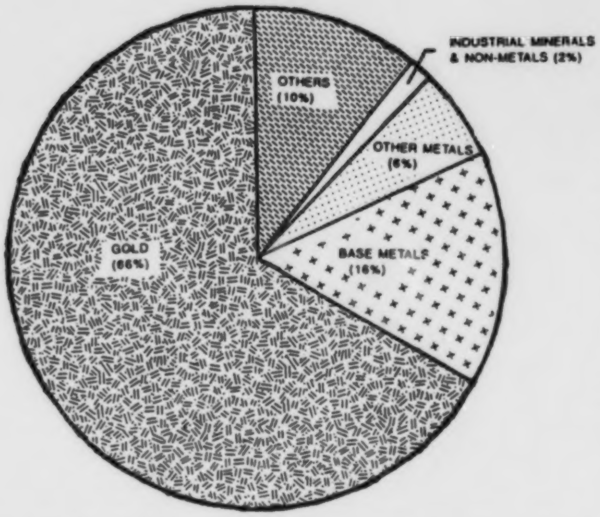


Figure 5.5. Drill hole purpose and/or principal commodity sheet, indicated as a proportion of total amount of drill core stored at the Tunder Bay Drill Core Library.

There are three geological environments where cobalt is found in the Thunder Bay District; low temperature Ag-Ni-Co-As veins; mafic and ultramafic intrusives; and sulphide-facies iron formation. The only significant example of the first is the Silver Islet Mine. Most other silver and base metal Proterozoic low temperature veins do not contain the Ni-Co-As assemblage.

SHEBANDOWAN MINE

Outside of the Sudbury District, Thunder Bay is the only other producer of cobalt. The Shebandowan Mine of Inco Ltd. produces a copper-nickel concentrate with an undisclosed amount of precious metals and cobalt. The massive to disseminated pyrrhotite-pentlandite-chalcopyrite ore is hosted by a highly sheared ultramafic intrusive or extrusive.

NORTH COLDSTREAM MINE

The North Coldstream Mine, at Burchell Lake, also had high cobalt values. The mine systematically assayed drill core for cobalt. The Number 1 zone, still exposed at surface near the Number One shaft, is particularly enriched. A grab sample collected by this office assayed 3623 ppm Co. This sample also had 5788 ppm Ni, 1.4% As, 136 ppm Bi, 94 ppm Sb, 85 ppm W, 1282 ppm Sr, and 470 ppb Au. The following are assays from a diamond-drill hole intersecting this zone expressed in percent Co/feet; 0.37/3.0, 0.32/5.0, 0.40/1.3, 0.22/3.7, 0.26/5.0, 0.22/5.0, 0.37/5.0, 0.31/5.1. The mineralization consist of stringer and disseminated pyrite and chalcopyrite hosted by a body of virtually pure microcrystalline quartz, 130 m by 300 m in size. This zone is most likely silicified gabbro.

PUDDY LAKE

Two samples collected by prospector Knut Kuhner and assayed by this office from an ultramafic intrusion at Puddy Lake contained 2720 and 3680 ppm Co. High base and precious metal values are associated with magnetite enriched alteration zones flanking 2 m wide shear zones. Commerce Nickel Mines Ltd. drilled this property in 1968 and produced values of 0.06 and 0.07% Co (Resident Geologist's files, Thunder Bay District, Thunder Bay). Puddy Lake is located 160 km north of Thunder Bay.

QUETICO FAULT MAFIC INTRUSIVES

Cobalt also occurs in gabbroic complexes such as at Lac des Iles, Crystal Lake and a few intrusions along the Quetico Fault near Atikokan. For example, samples collected by this office from the Kawene Intrusion were as high as 410 ppm Co and the Plateau Lake Intrusion 700 ppm Co. Cobalt is associated with sulphides in quantities ranging from 50 to 500 ppm and will end up in any sulphide concentrate produced as a valuable by-product.

Table 5.6. Drill core collected by Thunder Bay Drill Core Library staff during 1991.

	Company/Individual	Property/Location	Year Drilled	Number of Holes	Metres of Core stored
1)	Newmont Exploration of Canada Ltd.	Crayfish and Kashabowie lakes areas	1987	10	2651
2)	Freeport–McMoRan Gold Company	Crayfish and Kashabowie lakes areas	1989	9	2478
3)	Bond Gold Canada Inc.	Hemlo West/Lecours Twp.	1989	1	166
4)	Hemlo Gold Mines Inc.	Golden Giant Mine/Hemlo	1991	1	95
5)	Teck–Corona Operating Corp.	David Bell Mine/Hemlo	1990	1	125
6)	Williams Operating Corp.	Williams Mine/Hemlo	1988	1	70
7)	Fleck Resources Ltd.	Kawene/Hutchinson and Trottier Townships	1987, 1988	4	352
8)	Gunnar Gold Inc.	Sandra and Meadre Twps.	1987	2	221

ATIKOKAN IRON MINE

The largest resource of cobalt in this district may be within the Atikokan River Intrusions in McCaul and Hutchinson townships and in the Finlayson Lake area. Exploration, of the property best known as the Atikokan Iron Mine and the on strike extension of this iron formation, over the last 100 years has indicated the possibility of economically recoverable amounts of cobalt. The most definitive work on assessing this potential was carried out by Monteagle Exploration Ltd. and Paulpic Gold Mines Ltd. in a joint venture in 1970–71. (Resident Geologist's files, Thunder Bay District, Thunder Bay). Hole M-2 intersected 115 feet (100 feet—horizontal width) which assayed 0.46% Cu and 2.12 lbs/ton Co on the Monteagle property. Hole P-1 intersected 100 feet (95 feet—horizontal width) which assayed 0.41% copper and 1.17 lbs/ton Co on the Paulpic property. Results for the other 17 holes are also available. A composite sample of the sulphide rich intersections underwent metallurgical testing at the Department of Energy Mines and Resources. The results, as reported by the joint venture partners, are 0.8% Co and 0.8% Ni. A.D. MacTavish and R.J.A. Dutka describe this deposit as highly sheared and hydrothermally altered mafic to ultramafic rock in which massive magnetite lenses contain variable amounts of pyrite, pyrrhotite and chalcopyrite (Patterson et al. 1986).

FINLAYSON LAKE

A.D. MacTavish and R.J.A. Dutka, (Patterson et al. 1984, 1985, 1986), while carrying out a study of sulphide occurrences in the Finlayson Lake area, assayed sulphide-facies banded iron formation for most base and precious metals. Many of these iron formations contained elevated values of cobalt. These assays are plotted on Figure 5.7.

Table 5.7. Drill core stored at the Thunder Bay Drill Core Library, listed by principal commodity sought, or target.

Commodity	Type	Amount (in metres)	Percent
Gold	Grassroots	53 456	47.70
	Advanced	18 784	16.76
	Mines	1 418	1.27
Base Metals (Cu, Zn, Ni, Pb)	Grassroots	14 494	13.11
	Advanced	2 789	2.49
	Mines	568	0.51
Other Metals (Fe, U. PGE, Ag)	Exploration	6 991	6.24
Industrial Minerals and non-metals	Exploration	1 652	1.47
Other	Geotechnical, overburden and multiple targets	11 710	10.45
TOTAL		112 062	100.00

Gold, PGMs and Base Metals

ONION LAKE

Recent logging and road construction west of Onion Lake (lat. 48°40'N, long. 89°09'W) and east of Highway 527 at mileage 11 has opened up territory that has been inaccessible. Rock types exposed in the road system west of Onion Lake are indicated to be metasedimentary by Pye and Fenwick (1965). Near the southend of the road system east of Barnum Lake, these metasedimentary rocks appear to be very deformed and contain numerous en echelon and sigmoidal quartz veins and rusty zones. The largest quartz vein seen was up to 1.5 m wide with a zoned internal fabric. Pyrite and chalcopyrite was noted in the vein system. There is a known copper occurrence on Onion Lake.

WALKINSHAW LAKE

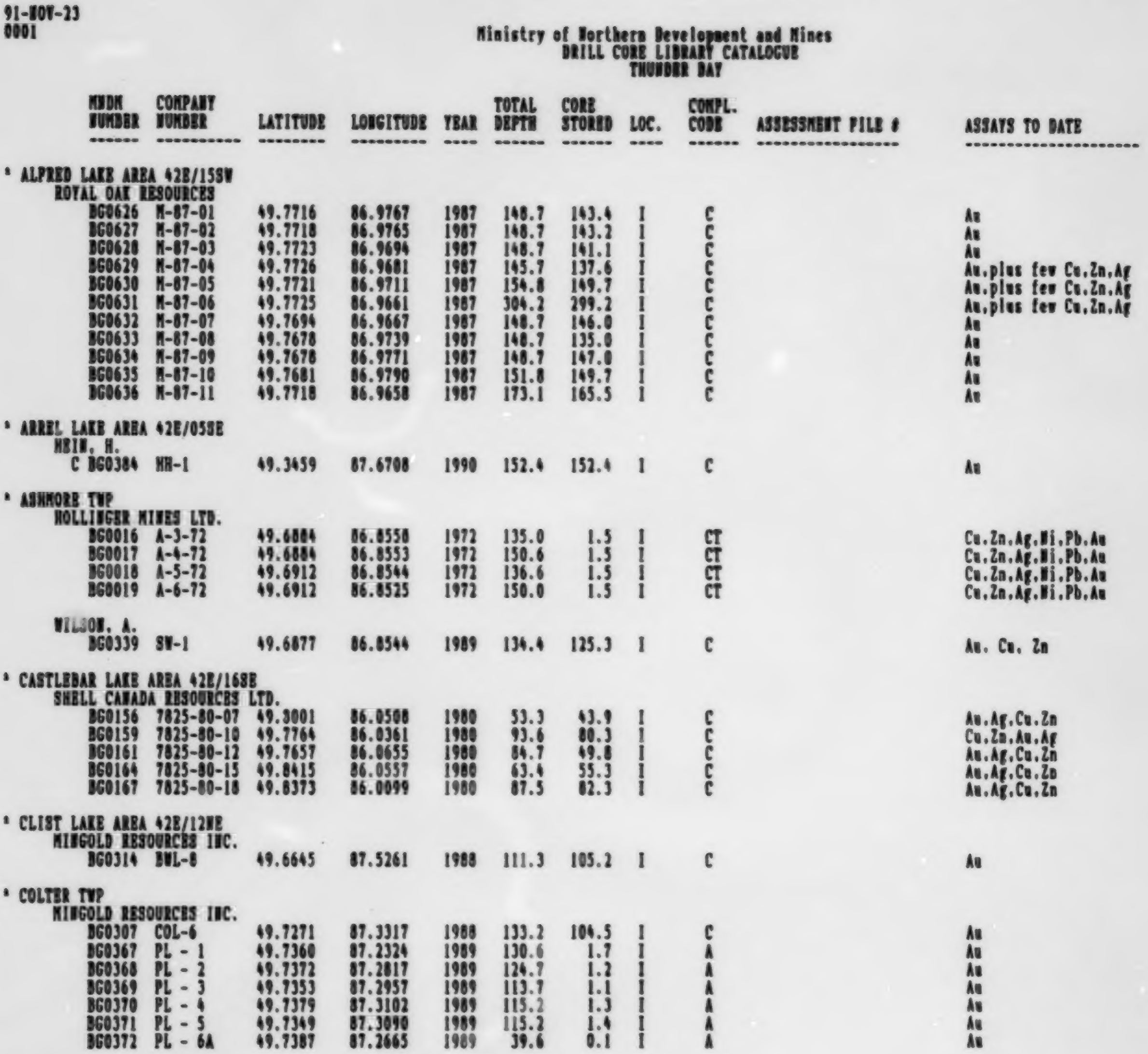
Extensive logging east of Highway 527 south and east of Walkinshaw Lake has exposed unmapped volcanic and sedimentary rocks. A new road, subparallel to the north boundary of MacGregor Township, has exposed a disseminated sulphide zone in metavolcanic rocks that is at least 12 m wide and is exposed for about 30 m along the road. Analysis of grab samples yielded just trace amounts of gold and base metals. Nevertheless the area should be explored. The recent Aerodat survey released by the Ontario Geological Survey indicates a weak EM anomaly exists on strike with this zone to the west along apparently the same horizon. This area is the north boundary of mapping by Scott (1990).

DOG RIVER

The Dog River area should be investigated for base metals as well as PGMs. This area is situated northeast of Raith and west of Dog Lake. The current geological interpretation as outlined in Government maps is subject to review and is in a state of flux as new ideas are put forward. Samples obtained from this area were predominately coarse mafic volcanics or coarse-grained mafic intrusions. In 1970 Falconbridge Nickel Mines Ltd. drilled a property near Fisher Lake and intersected serpentinized pyroxenites containing up to 10% pyrrhotite in the drill hole (Resident Geologist's files, Thunder Bay District, Thunder Bay). No assays were reported.

PROTEROZOIC COPPER

Recently some interest has been shown in copper mineralization of Proterozoic age. Of particular importance is the Sibley Group as well as Keweenawan basalts and intrusives located on Black Bay Peninsula and in the Pigeon River area. Copper mineralization in the Sibley Group is found in the Middle Rossport Formation stromatolites and as disseminated chalcopyrite, bornite or chalcocite plus malachite alteration associated with mudstones in the Dorion area. Occurrences of



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91-NOV-23
0001
                                        Ministry of Northern Development and Mines
                                                 DRILL CORE LIBRARY CATALOGUE
                                                         THUNDER BAY

         MNDM   COMPANY                                       TOTAL  CORE          COMPL.
         NUMBER NUMBER      LATITUDE  LONGITUDE  YEAR DEPTH  STORED LOC.  CODE   ASSESSMENT FILE #      ASSAYS TO DATE
         ------ ----------- --------- ---------- ---- ------ ------ ----  ------ -----------------      ---------------------

* ALFRED LAKE AREA 42E/15SW
     ROYAL OAK RESOURCES
         BG0626 M-87-01     49.7716   86.9767    1987  148.7  143.4  I      C                           Au
         BG0627 M-87-02     49.7718   86.9765    1987  148.7  143.2  I      C                           Au
         BG0628 M-87-03     49.7723   86.9694    1987  148.7  141.1  I      C                           Au
         BG0629 M-87-04     49.7726   86.9681    1987  145.7  137.6  I      C                           Au,plus few Cu,Zn,Ag
         BG0630 M-87-05     49.7721   86.9711    1987  154.8  149.7  I      C                           Au,plus few Cu,Zn,Ag
         BG0631 M-87-06     49.7725   86.9661    1987  304.2  299.2  I      C                           Au,plus few Cu,Zn,Ag
         BG0632 M-87-07     49.7694   86.9667    1987  148.7  146.0  I      C                           Au
         BG0633 M-87-08     49.7678   86.9739    1987  148.7  135.0  I      C                           Au
         BG0634 M-87-09     49.7678   86.9771    1987  148.7  147.0  I      C                           Au
         BG0635 M-87-10     49.7681   86.9790    1987  151.8  149.7  I      C                           Au
         BG0636 M-87-11     49.7718   86.9658    1987  173.1  165.5  I      C                           Au

* ARREL LAKE AREA 42E/05SE
     HEIN, H.
       C BG0384 HH-1        49.3459   87.6708    1990  152.4  152.4  I      C                           Au

* ASHMORE TWP
     HOLLINGER MINES LTD.
         BG0016 A-3-72      49.6884   86.8558    1972  135.0    1.5  I      CT                          Cu,Zn,Ag,Ni,Pb,Au
         BG0017 A-4-72      49.6884   86.8553    1972  150.6    1.5  I      CT                          Cu,Zn,Ag,Ni,Pb,Au
         BG0018 A-5-72      49.6912   86.8544    1972  136.6    1.5  I      CT                          Cu,Zn,Ag,Ni,Pb,Au
         BG0019 A-6-72      49.6912   86.8525    1972  150.0    1.5  I      CT                          Cu,Zn,Ag,Ni,Pb,Au

     WILSON, A.
         BG0339 SW-1        49.6877   86.8544    1989  134.4  125.3  I      C                           Au, Cu, Zn

* CASTLEBAR LAKE AREA 42E/16SE
     SHELL CANADA RESOURCES LTD.
         BG0156 7825-80-07  49.3001   86.0508    1980   53.3   43.9  I      C                           Au,Ag,Cu,Zn
         BG0159 7825-80-10  49.7764   86.0361    1980   93.6   80.3  I      C                           Cu,Zn,Au,Ag
         BG0161 7825-80-12  49.7657   86.0655    1980   84.7   49.8  I      C                           Au,Ag,Cu,Zn
         BG0164 7825-80-15  49.8415   86.0557    1980   63.4   55.3  I      C                           Au,Ag,Cu,Zn
         BG0167 7825-80-18  49.8373   86.0099    1980   87.5   82.3  I      C                           Au,Ag,Cu,Zn

* CLIST LAKE AREA 42E/12NE
     MINGOLD RESOURCES INC.
         BG0314 BWL-8       49.6645   87.5261    1988  111.3  105.2  I      C                           Au

* COLTER TWP
     MINGOLD RESOURCES INC.
         BG0307 COL-6       49.7271   87.3317    1988  133.2  104.5  I      C                           Au
         BG0367 PL - 1      49.7360   87.2324    1989  130.6    1.7  I      A                           Au
         BG0368 PL - 2      49.7372   87.2817    1989  124.7    1.2  I      A                           Au
         BG0369 PL - 3      49.7353   87.2957    1989  113.7    1.1  I      A                           Au
         BG0370 PL - 4      49.7379   87.3102    1989  115.2    1.3  I      A                           Au
         BG0371 PL - 5      49.7349   87.3090    1989  115.2    1.4  I      A                           Au
         BG0372 PL - 6A     49.7387   87.2665    1989   39.6    0.1  I      A                           Au
```

Figure 5.6. A page from the Thunder Bay Drill Core Library Catalogue.

native copper have been reported in the area between Thunder Bay and the United States border. Native copper occurs as blebs and nuggets in beach deposits, as concentrations in amygdular basalts located in Blake Township (Resident Geologist's files, Thunder Bay District, Thunder Bay) and as placer-like deposits in alluvium (R. Kwiatkowski, Prospector, personal communication, 1991).

In the area south of Lake Nipigon, the 1979 lake bottom geochemical survey indicates the presence of a regional copper anomaly in the vicinity of lat. 49°30′N, long. 89°00′W. Portions of the anomaly can be traced southward along long. 89°00′W to about lat. 49°00′N. The geology of this area is predominantly Sibley Group red-bed sedimentary rocks that have been intruded by mafic to ultramafic plugs, sills and dikes. Geochemical values as high as 1080 ppm Cu have been documented (Coker and Ellwood 1981) in the area just south of Grand Bay, west of McIntyre Bay of Lake Nipigon.

SHEBANDOWAN AIRBORNE GEOPHYSICAL SURVEY

A judicious study of the recent Thunder Bay–Shebandowan airborne release should be done now that the initial thrust has diminished. While the obvious anomalies have been staked and are in the process of being evaluated, there are many trends that should receive attention from a mineral exploration point of view. With more than 20 740 electromagnetic intercepts it should be a full time job to examine most of them.

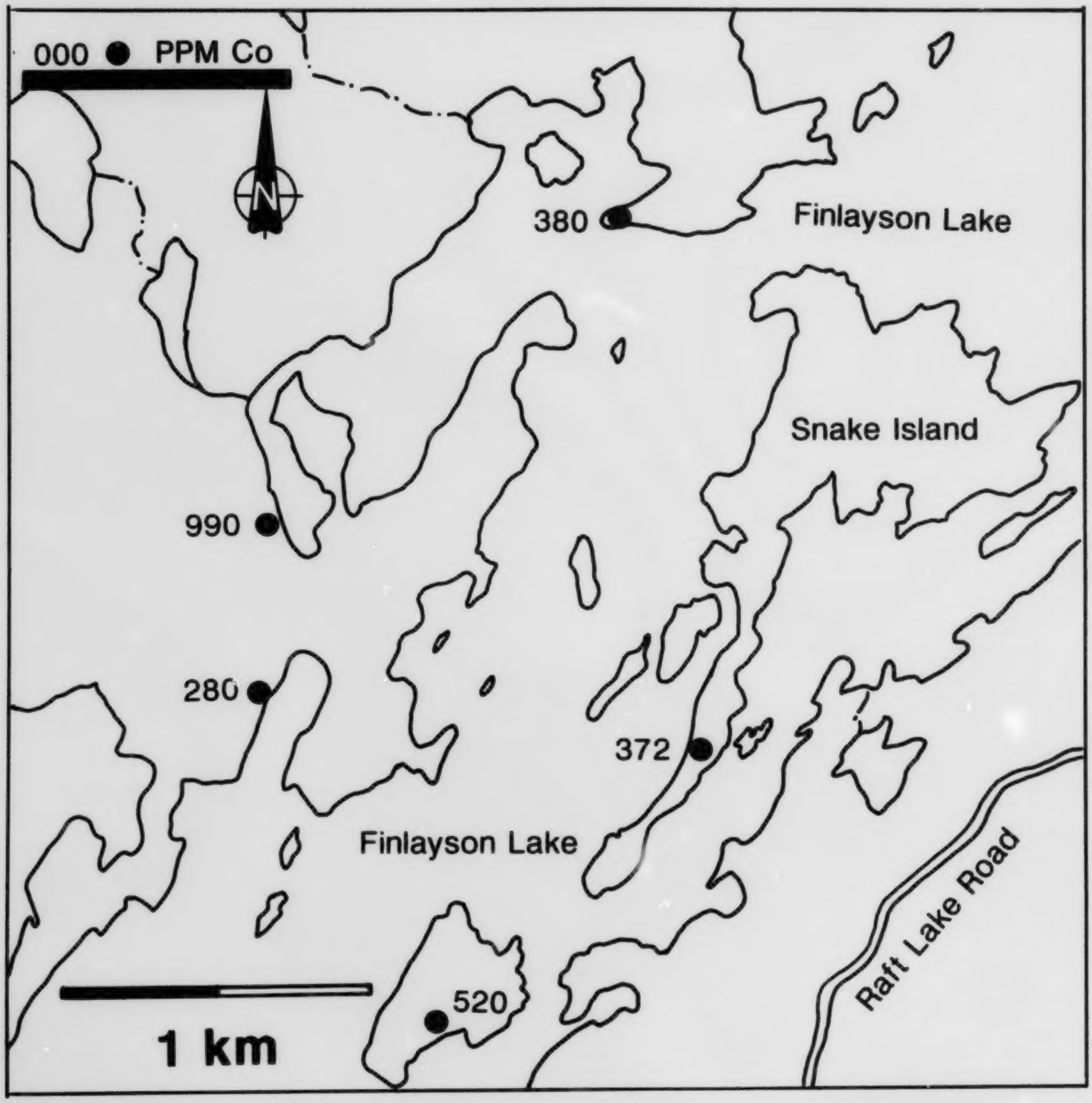

Figure 5.7. Cobalt occurrences in the Finlayson Lake area.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

I.A. Osmani, Geologist, Precambrian Section carried out one inch to one quarter mile geological mapping of Moss Township. This area contains the past gold and silver producer, the Jackfish Mine (Ardeen), and Central Crude's Moss Lake property.

W.S. Shanks, Geologist, Precambrian Section, carried out one inch to one quarter mile geological mapping of the Wild Potato Lake Area, which is at the boundary of this district with the Kenora District. This area is considered to have high mineral potential as it is transected by several deformation zones.

RESEARCH BY OTHER AGENCIES

Lakehead University

J. Dehls—Magnetic fabrics and petrofabrics of the Seine River Sandstone, Mine Centre.

R. Purdon—Hydrogeochemical study of Boreal Watershed

B. Seemayer—Variation in metamorphic grade in metapelites from the Quetico Subprovince, Thunder Bay

J. Selway—Platinum group element mineralogy of ultrabasic and basic intrusions in the Quetico Subprovince

T. Werner—Paleomagnetism of the Quetico-Shebandowan belt boundary

J. Xiong—Geochemistry and mineralogy of granitoid rocks in the Thunder Bay area

A. MacTavish—Geology of Quetico intrusions

Queen's University, Belfast, N. Ireland

P. F. Carey is carrying out metal analysis of Proterozoic bitumen

Okayama University, Misasa, Japan

R. Hori is studying Gunflint Formation chert

Geological Survey of Canada

CENTRE FOR REMOTE SENSING

A synthetic-aperture radar (SAR) survey was flown in the Thunder Bay area.

AIRBORNE GEOPHYSICS SECTION

K.L. Ford conducted ground checks of airborne gamma ray spectrometric survey anomalies in the Black Sturgeon Lake area.

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—— 1986. Thunder Bay Resident Geologists area Northwest Region, *in* Report of Activities 1985, Regional and Resident Geologists, Ontario Geological Survey, Miscellaneous Paper 128, p.70–148.

—— 1987. Thunder Bay Resident Geologists area Northwest Region, *in* Report of Activities 1986, Regional and Resident Geologists, Ontario Geological Survey, Miscellaneous Paper 134, p.72–124.

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6. Beardmore–Geraldton Resident Geologist's District—1991

J.K. Mason[1] and G.D. White[2]

[1]Resident Geologist, Thunder Bay, Field Services Section, Ontario Geological Survey – Information Services Branch

[2]Geologist, Thunder Bay, Field Services Section, Ontario Geological Survey – Information Services Branch

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INTRODUCTION

The Beardmore–Geraldton Resident Geologist's Office operates within the Thunder Bay Mining Division. The Beardmore–Geraldton District is outlined on Figures 6.1 and 6.2 and includes the communities of Beardmore, Jellicoe, Geraldton, Longlac, Nakina, Fort Hope, Lansdowne House, Summer Beaver and Webequie. Approximately 72 exploration programs were undertaken in the Beardmore–Geraldton Resident Geologist's District by prospectors, junior companies and major companies.

The Ontario Prospectors Assistance Program (OPAP) funded 55 programs in the Beardmore—Geraldton District totalling $525 051 and representing 13% of the provincial total. The Ontario Mineral Incentive Program fund paid out $480 443 through 10 grants in the district.

EXPLORATION ACTIVITY

Prospector programs accounted for 65% of exploration programs in the Beardmore–Geraldton area. Sixty-five percent of the 72 programs undertaken by prospectors, junior companies and major companies were for gold. The Beardmore–Jellicoe–Onaman Lake portion of the district was the main focus of exploration.

In September, Ontex Resources Ltd. signed a letter of intent with Placer Dome Inc. permitting the major to earn up to a 60% interest in the Brookbank gold deposit, Irwin Township, in exchange for spending $13 million on exploration and development. Ontex was originally awarded the Brookbank property and 471 mining claims as part of an Ontario Supreme Court decision made in December of 1990. Metalore Resources Limited has since appealed the decision (*The Northern Miner*, September 20, 1991).

The Magnet Mine, Errington Township, held by Roxmark Mines Limited, and the Pan–Empire Mill, Summers Township, held by Ateba Mines Inc., remained in a "care and maintenance" status.

Assessment work and claim summaries for the Thunder Bay Mining Division is given in Table 5.1 of Lavigne et al. (this volume). A summary of exploration programs undertaken in the Beardmore–Geraldton Resident Geologist's District is found in Table 6.1.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

Staff of the Beardmore–Geraldton Resident Geologist's District includes: J. Mason, Resident Geologist; G. White, Staff Geologist; C. Komar, Secretary; and S. Warren, Secretary and Assessment File Clerk.

The Beardmore–Geraldton Resident Geologist's staff provided consultation and geological data to prospectors, mining company geologists, consultants and native groups. Property visits (Figure 6.1), field trips, prospector classes and mineral information talks were delivered.

Field offices in Beardmore and Geraldton were staffed for the months of May to October on a weekly, part-time basis. The Ministry of Northern Development and Mines office (Northern Development and Transportation Division) in Geraldton serves as the Geraldton field office and the Beardmore municipal office hosts the Beardmore field office.

The Resident Geologist's Program handled 654 personal consultations and 418 phone inquiries in the Beardmore, Geraldton and Thunder Bay offices. The office containing the Thunder Bay Mining Division assessment files received 744 inquiries and 108 phone calls.

The senior author completed participation in developing the assessment work portion of the new Mining Act (a two-year process).

Geology and mineral potential presentations were delivered to the Kasabonika Lake First Nation and the Eabametoong (Fort Hope) First Nation.

Three field trips were delivered to industry personnel and to E. Solonyka, Supervisor, Incentives Office. Thirty-five property visits were undertaken.

The authors in conjunction with the Greenstone Economic Development Corporation and the communities of Beardmore, Geraldton, Longlac and Nakina hosted a booth at the Prospectors and Developers convention in Toronto.

Prospector classes were delivered in Nipigon and Thunder Bay in conjunction with Thunder Bay office staff.

The authors presented an exploration talk and poster display at the Northwestern Ontario Mines and Minerals

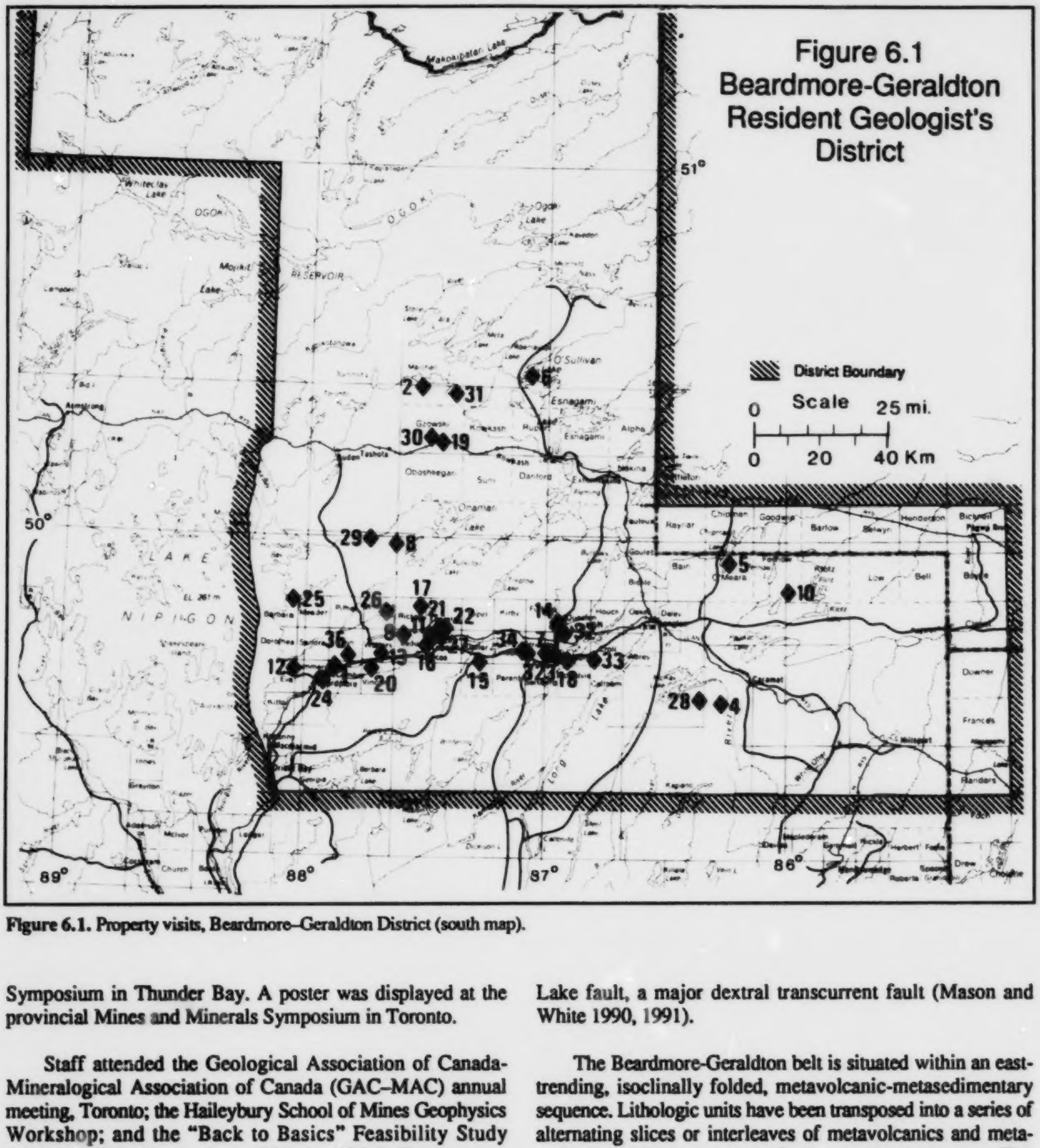
Figure 6.1
Beardmore-Geraldton
Resident Geologist's
District
District Boundary
Scale
0
25 mi.
0
20
40 Km
51°
50°
89°
88°
87°
86°
Makokibatan Lake
OGOKI RESERVOIR
Ogoki Lake
O'Sullivan
Esnagami
Onaman Lake
LAKE NIPIGON
Long Lake
2
31
6
30
19
29
8
5
10
25
26
17
21
22
14
36
9
11
32
34
7
3
12
13
16
27
15
33
23
18
1
20
24
28
4

Figure 6.1. Property visits, Beardmore–Geraldton District (south map).

Symposium in Thunder Bay. A poster was displayed at the provincial Mines and Minerals Symposium in Toronto.

Staff attended the Geological Association of Canada-Mineralogical Association of Canada (GAC–MAC) annual meeting, Toronto; the Haileybury School of Mines Geophysics Workshop; and the "Back to Basics" Feasibility Study Seminar—Canadian Institute of Mining (CIM), Toronto.

PROPERTY EXAMINATIONS

General Geology and Structure

The geology of the Beardmore–Geraldton area, the east portion of the Wabigoon Subprovince, has been divided into 2 belts: 1) the Beardmore–Geraldton belt, and 2) the Onaman–Tashota metavolcanic belt. The belts are separated by the Paint Lake fault, a major dextral transcurrent fault (Mason and White 1990, 1991).

The Beardmore-Geraldton belt is situated within an east-trending, isoclinally folded, metavolcanic-metasedimentary sequence. Lithologic units have been transposed into a series of alternating slices or interleaves of metavolcanics and metasediments within a wrench fault or megashear zone. The Beardmore–Geraldton belt has been subdivided lithologically into 1) the Southern metavolcanic subbelt and 2) the Southern metasedimentary subbelt.

The Onaman–Tashota metavolcanic belt is a felsic to mafic, calc-alkalic and tholeiitic metavolcanic sequence bounded to the south by the Paint Lake fault.

A detailed description of the geology and the gold mineralization of the Beardmore–Geraldton belt and Onaman–Tashota

EXPLANATION

◆ Property Visits, 1991

1. Angle Lake Occurrence (R. MacAdam)
2. Banana Lake Property
3. Bankfield Mine (Golden Trio Minerals Ltd.)
4. Caramat Cu-Ni Occurrence (O. Albert)
5. Chipman Lake Cu Occurrence (G. Royer)
6. Consolidated Louanna Gold Mine
(Cumo Resources Ltd./Pelham Gold 'N' Grain Inc.)
7. Consolidated Mosher Mine (Lac Minerals Ltd.)
8. Cox–Onaman Occurrences (N. Cox)
9. Expansion Lake Occurrence (Founder Resources Inc.)
10. Fernow Township Occurrence (T. Head)
11. Goodman–Sturgeon River Property (H. Goodman Sr.)
12. Gustafson Occurrence (H. Goodman Jr.)
13. Houghton 801 Occurrence (Freewest Resources Inc.)
14. Hutchison Lake Mine (Royal Oak Resources Ltd.)
15. J. Rapski Occurrence (J. Rapski)
16. J. Savage Occurrence (J. & L. Savage)
17. Larson Occurrence
(Consolidated Gold Hawk Resources Inc./Noranda Exploration Company Ltd.)
18. MacLeod–Cockshutt Mine (Lac Minerals Ltd.)
19. McFarlane–Manion Occurrence (G. Milks, C. Paul)
20. Maki Occurrences (N. Maki)
21. Missing Link Extension Occurrence (Freewest Resources Inc.)
22. Missing Link Occurrence (Placer Dome Inc.)
23. Mosher–Talmora Diorite Occurrence (Lac Minerals Ltd.)
24. Northern Empire Mine (Ateba Mines Inc.)
25. Northwind Lake Property (B. Michon)
26. O'Neil Creek Occurrence (A. Douglas)
27. Partridge Lake Occurrence (F. Checkley)
28. Pout Lake Cu Occurrence (R. & G. Gionet)
29. R. Côté–Onaman Occurrence (R. Côté)
30. Royal Crown Occurrence (G. Milks, C. Paul)
31. Sollas Lake Property (B. Mehaffey)
32. Swereda–Ashmore Occurrence (M. Swereda)
33. Swereda–Croll Occurrence (M. Swereda)
34. Tombill Mine (Tombill Mines Ltd.)
35. Watson Lake Occurrence (Wiscan Resources Inc./C. Pettit)

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metavolcanic belt is provided in Mason and White (1986), in Patterson et al. (1984, 1985), Mason et al. (1988, 1989) and Stott (1984).

Beardmore–Geraldton Belt

MAKI OCCURRENCES

The Maki occurrences are located in the northern portion of Vincent Township. The property is accessible by travelling Highway 11 east of the Windigokan Lake access road to the township boundary road between McComber and Vincent townships and then south to Norman Lake. After crossing Norman Lake by boat, a system of old logging roads, grid lines and claim lines access approximately 30 gold occurrences and prospects on the Maki claim block. N. Maki, A. Maki, M. Maki, S. Moore and B. Cousineau are the property owners. Work in 1990 and 1991, which was largely funded by the Ontario Prospectors Assistance Program (OPAP), consisted of power stripping, trenching, sampling and mapping. This summary will focus on newly discovered gold occurrences located in the western and central portion of the claim block.

The earliest recorded work was performed near the current south boundary of the Maki block in the township by "Pegleg" Westman in 1928 and consisted of trenching and sampling. The Hilo Gold Syndicate (1937) and Longworth Group conducted trenching in the central portion of the claim block. Dougall Gold Mines Ltd. (1947) diamond-drilled veins and iron formation targets mainly near what is presently called "Sandra's Pit". Dougall acquired most of their claims from Sandenise Gold Mines Limited. Sogemines Development Co. Ltd. (1959) and Hanson Mines Limited (1971–1974) performed diamond drilling. The current owner staked the property in 1977. Three companies have held options from 1981 to present: 1) Pancontinental Mining (Canada) Limited (1981, 1982)—

Table 6.1. Exploration programs in the Beardmore–Geraldton District.

Abbreviations

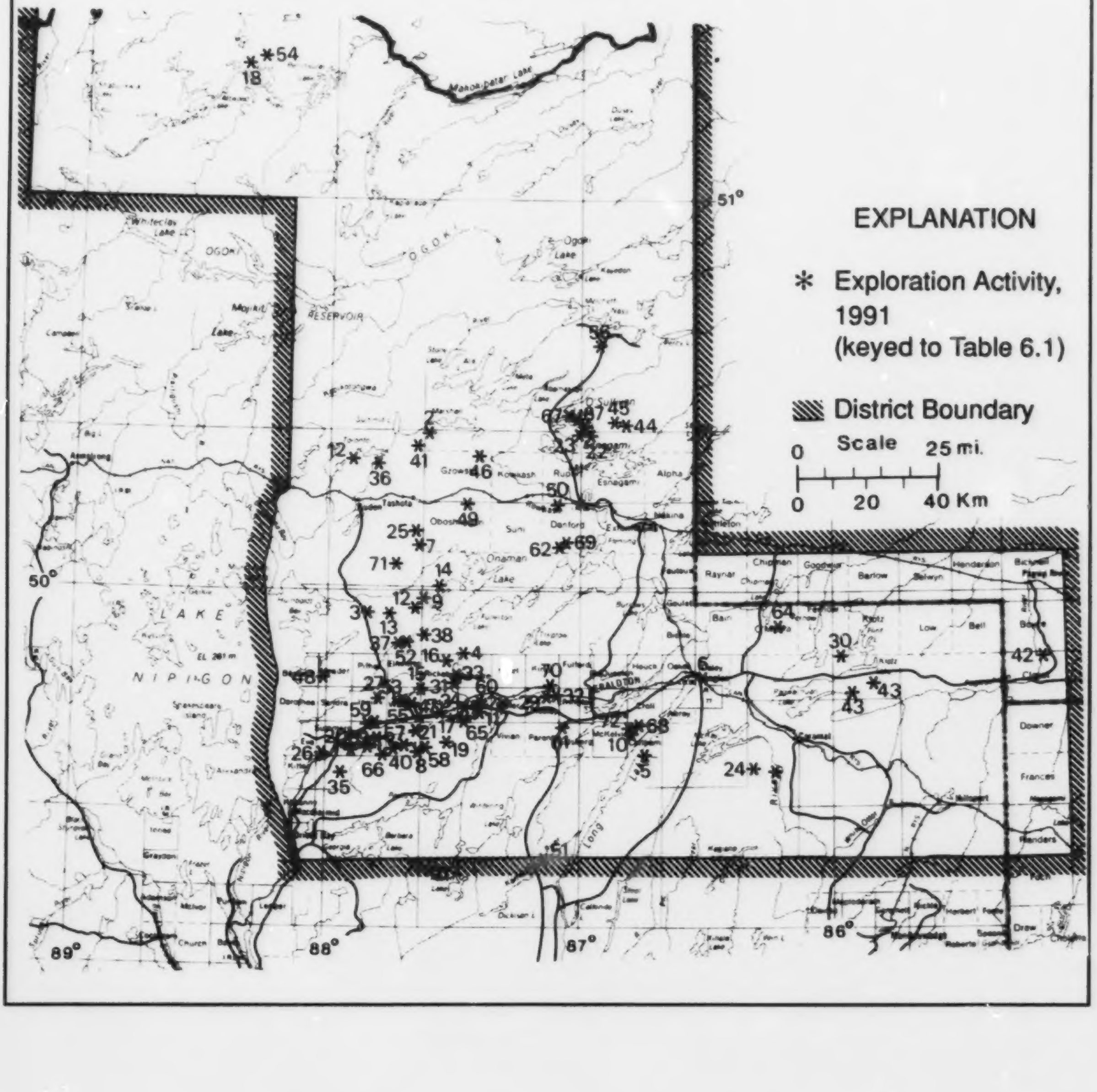
AEM	Airborne electromagnetic survey	IP	Induced polarization survey
AMag	Airborne magnetometer survey	Mag	Magnetometer survey
ARad	Airborne radiometric survey	Res	Resistivity survey
DDH	Diamond-drill hole	Rad	Radiometric survey
EM	Electromagnetic survey	UG	Underground work
HLEM	Horizontal-loop electromagnetic survey	VLF	very low frequency electromagnetic survey

Company/Individual	Township/Area	Exploration
1) Onesime Albert	Pic River	prospecting
2) Samuel Amukun	Marshall Lake	geology
3) Asarco Exploration Co. of Canada Ltd.	Onaman River	DDH
4) Tony Auger and Lyle Holt	Fullerton Lake	stripping, trenching, geochemistry
5) Rachel Brinklow	Coltham Township	trenching, geochemistry
6) William Brinklow	Oakes and Daley Townships	trenching, geochemistry
7) Callisto Minerals Incorporated	Metcalfe Lake	lake sediment, geochemistry
8) Canalaskan Industries	Vincent Township	Rad
9) Castlewood Metals and Explorations Ltd.	Onaman Lake	stripping, trenching, line cutting, geophysics, geochemistry
10) Cayuga Syndicate	Ashmore Township	DDH
11) Fred Checkley	Legault Township	stripping, trenching, geochemistry
12) Garry Clark	Toronto Lake	prospecting, geology, geochemistry
13) Robert Cote	Onaman River	prospecting, stripping, geochemistry
14) Nolan Cox	Coughlan Lake	stripping, trenching, geochemistry
15) Arthur Douglas	O'Neil Creek	stripping, trenching, geochemistry
16) Arthur Douglas	O'Neil Lake	trenching, geochemistry
17) Cameron Enders and Darren Goodman	Leduc Township	stripping, trenching, geochemistry
18) Falconbridge Limited	Kawitos Lake	line cutting, geophysics, DDH
19) Founder Resources Inc.	Leduc Township	prospecting, biogeochemistry
20) Freewest Resources Inc.	Summers Township	prospecting, stripping, trenching, geochemistry
21) Freewest Resources Inc.	Walters Township	prospecting, line cutting, geophysics
22) Frank Gagnon	O'Sullivan Lake	DDH
23) Walter Gagnon	O'Sullivan Lake	trenching, DDH
24) Reg Gionet and Gilles Gionet	Pout Lake	prospecting
25) Frank Goodman	Tashota	prospecting, geochemistry
26) Herb Goodman Jr.	Eva Township	stripping, trenching, geochemistry
27) Herb Goodman Jr.	Pifher Township	stripping, trenching, geochemistry
28) Herbert Goodman and Jean Marc Leclerc	Legault Township	stripping, geochemistry
29) Granges Inc.	Kirby Township	DDH
30) Thomas Head	Fernow Township	trenching, prospecting, geochemistry
31) Hemlo Gold Mines Inc.- Consolidated Gold Hawk Resources Inc.	Rickaby Township	line cutting, geophysics
32) Homestake Canada Ltd.	Kirby Township	DDH
33) Frank Houghton	Rickaby Township	prospecting, geochemistry

Table 6.1. Continued.

Company/Individual	Township/Area	Exploration
34) Raymond Koivisto	Leduc Township	prospecting
35) Amede Lafontaine	Summers Township	stripping, trenching, geochemistry
36) Claude Larouche	Toronto Lake	prospecting, geology, geochemistry
37) Pentti Lassila	Castlewood Lake	prospecting
38) Pentti Lassila	Onaman Lake	prospecting
39) Richard MacAdam	McComber Township	stripping, trenching, geochemistry
40) Neil Maki and Aili Maki	Vincent Township	stripping, trenching, geochemistry
41) Joseph McDermott and Nolan Cox	Gripp Lake	prospecting
42) McKinnon Prospecting	Boyce and Clavet Townships	line cutting, geology, geophysics, AMag, AEM
43) McKinnon Prospecting	Klotz Lake	line cutting, geology, geophysics
44) Andrew Megan	Muriel Lake	trenching
45) Angus Megan	Muriel Lake	trenching
46) Bob Mehaffey	Marshall Lake	prospecting, trenching, geochemistry
47) Metalore Resources Limited	Walters Township	geology
48) Robert Michano	Northwind Lake	prospecting
49) Gerald Milks and Charles Paul	Gzowski Township	stripping, trenching, geochemistry
50) Milner Consolidated Silver Mines Ltd.	Rupert Township	DDH, Mag, VLF, HLEM
51) Minnova Inc.	Kamuck River	line cutting, geology
52) Myron Nelson	Onaman Lake	stripping, geochemistry
53) Orient Resources Inc.	Elmhirst Township	DDH
54) Shaun Parent	Kawitos Lake	prospecting, geology, geochemistry
55) James Parres	Elmhirst Township	prospecting, DDH, Mag
56) Don Patrie	Melchett Lake	line cutting, geophysics
57) Cyril Petit	Irwin Township	stripping
58) Pichette Mining Explorations	Vincent Township	stripping, geochemistry
59) Placer Dome Inc.	Irwin Township	DDH
60) Placer Dome Inc.	Lapierre Township	DDH
61) Placer Dome Inc.	Lindsley Township	DDH
62) William Rainboth	Danford Township	DDH
63) Rio Algom Exploration Inc.	Kitchie Lake	geology, geochemistry
64) Guy Royer	O'Meara Township	prospecting
65) James Savage and Laurie Savage	Leduc Township	DDH, geochemistry
66) Ann Skalesky	McComber Township	prospecting
67) Michael Smith	O'Sullivan Lake	prospecting, geology, geochemistry
68) Mel Swereda	Croll Township	line cutting, DDH
69) Teck Exploration Inc.	Danford Township	line cutting, geophysics
70) Ozias Theriault	Kirby Township	stripping, trenching, geochemistry
71) Trump Reserve Minerals Ltd.	Elbow Lake	line cutting, geology, geochemistry
72) Alexander Wilson	Ashmore Township	DDH

Figure 6.2
Beardmore-Geraldton Resident Geologists' District
(south map)


EXPLANATION
✻ Exploration Activity, 1991 (keyed to Table 6.1)
▨ District Boundary
Scale
0 25 mi.
0 20 40 Km
51°
50°
89°
88°
87°
86°
Mahoabatar Lake
Whiteclay Lake
OGOKI RESERVOIR
Ogoki
Ogoki Lake
LAKE NIPIGON
Onaman Lake
Long Lake
Geraldton
Esnagami
Alpha
Danford
Robinson
Tashota
Grows
Kowkash
Raynar
Chipman
Goodchild
Barlow
Selwyn
Henderson
Bain
Low
Bell
Downer
Frances
Nipigon
54
18
56
45
44
67
12
36
41
46
50
25
7
49
62
69
71
14
12
9
3
13
38
37
52
16
4
33
27
15
31
60
70
32
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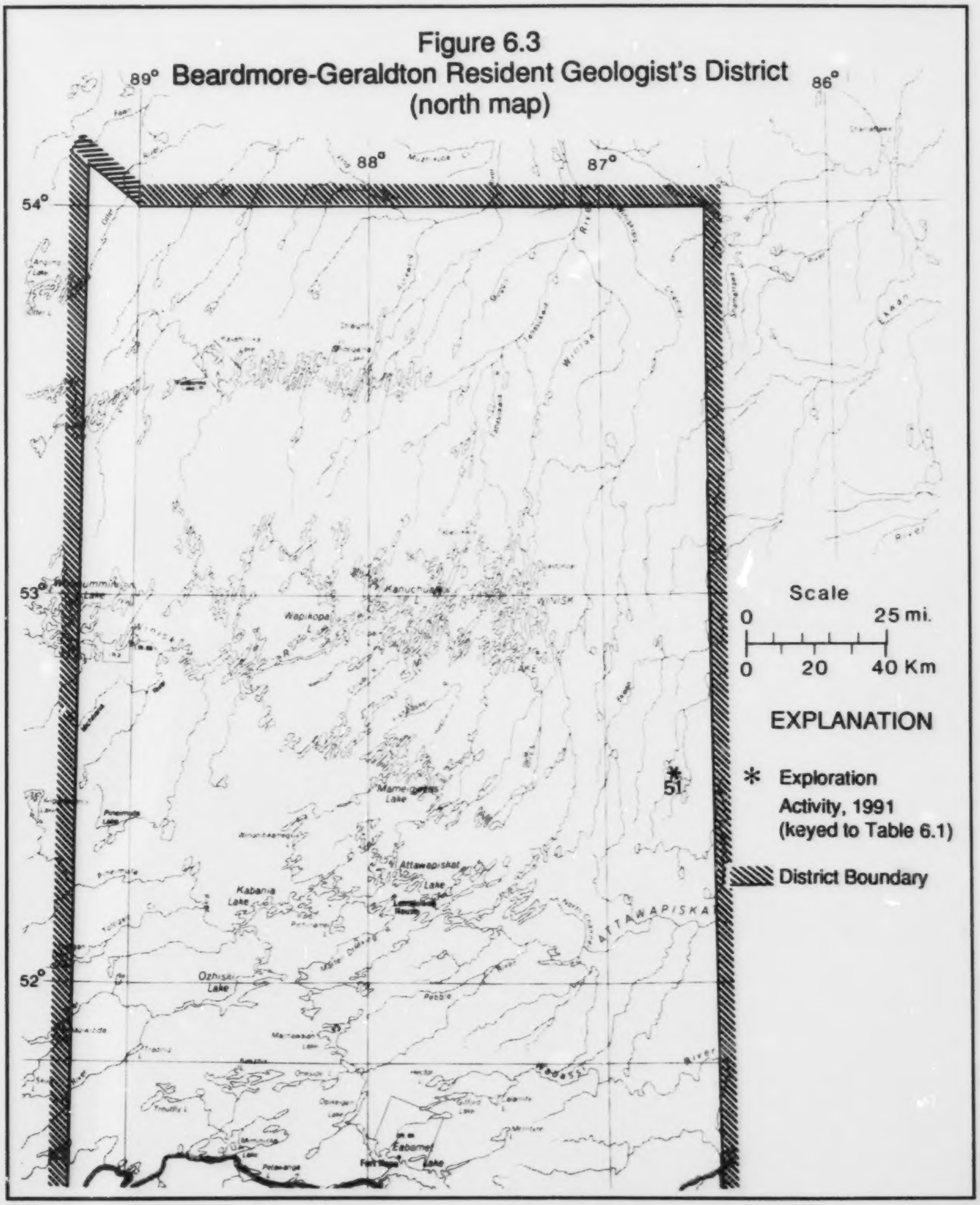
55
29
64
30
42
43
43
72
68
10
61
5
65
21
17
26
19
66
40
8
58
35
24
51

Figure 6.3
Beardmore-Geraldton Resident Geologist's District
(north map)


89°
86°
88°
87°
54°
53°
52°
Kanuchuan L.
Wapikopa L.
WINISK
Mameigwess Lake
Attawapiskat Lake
Kabania Lake
Ozhiski Lake
Eabamet Lake
Fort Hope
ATTAWAPISKAT
River
51
Scale
0
25 mi.
0
20
40 Km
EXPLANATION
* Exploration Activity, 1991 (keyed to Table 6.1)
▨ District Boundary

line cutting, sampling, geology; 2) Eldor Resources Limited (1983, 1984)—line cutting, geophysics, geology, sampling, drilling; and 3) Noranda Exploration Company Ltd. (1987, 1988)—geophysics, geology, drilling, sampling.

The Maki occurrences are hosted in the Southern Metavolcanic subbelt, the southern-most unit of the Wabigoon Subprovince. Basalt and mafic to intermediate tuffs, minor mafic and felsic intrusions along with chemical and minor associated interflow metasediments occur within the belt. Foliation is 070° to 095°. Rocks are metamorphosed to greenschist and amphibolite facies (Carter 1985).

Work in 1990 and 1991 was concentrated mainly in the central and western portions of the claim block on the following gold occurrences. Line terminology is in reference to the main grid previously established on the property.

1. Moosehorn, L (Line) 20 West and L (Line) 20 Extension occurrence.

2. KM vein and IF occurrence.

3. L (Line) 11 occurrence.

4. AM Zone L (Line) 30 West.

The Moosehorn vein (1), located immediately south of Edith Lake, is a discontinuous, folded quartz (carbonate) vein that cuts across and is hosted in massive mafic-flow rocks. Foliation of the metavolcanics is 080° and plunge of fold axes is 50° to 60° to the west. Interflow metasedimentary rocks occur locally. The folding event appears to have been responsible for a strong shear event in the Moosehorn area and L20 West, which may be a parallel quartz (carbonate) vein. In L20 West, foliation of the metavolcanics is 075° and plunge of the fold axes is 45° to the west. Both veins are up to 0.6 m wide and host galena, chalcopyrite, pyrite and gold mineralization. The sequence of events has been interpreted by the authors as follows: 1) volcanism; 2) regional deformation; 3) quartz veins and gold mineralization; and 4) folding/shearing event. The L20 Extension is up to 1.5 m wide and contains up to 2% chalcopyrite and pyrite.

The KM vein and IF occurrence (2) are located on the southwestern portion of the claim block on L18 (1 + 60 S) and consist of a banded magnetite (recrystallized)-chert-grunerite iron formation. The occurrence has been exposed for over 100 m and is up to 2.1 m wide. The KM vein is a quartz (carbonate) vein conformable with iron formation on the south contact with the mafic metavolcanics. The iron formation is east-trending and dips 60° to 72° to the south. Minor pyrite and pyrrhotite occur.

The L11 occurrence (3) consists of a quartz vein system crosscutting an easterly trending, banded magnetite-chert-grunerite iron formation. Sogemines Development Co. Ltd. had previously obtained assays of 0.24 ounce Au per ton over a 3 m width (N. Maki, Prospector, personal communication, 1990) composed volumetrically of approximately 40% quartz and 60% sheared mafic metavolcanics. The L11 occurrence is 170 m long, strikes 090° and dips 55° to 65° to the south.

The AM Zone (4) is made up of three parallel, banded iron formations located on the Maki grid between L3+00W, 0+35N and L4+40W, 0+35N. The previously worked "Sandra's Pit" is located approximately 150 m to the west. The AM Zone is represented by electromagnetic conductor CZ (Eldor Resources Limited). Recrystallized chert, magnetite and minor graphite make up the iron formation. Mafic metavolcanics and interflow metasediments occur in between creating a 10 to 12 m wide zone containing three parallel iron formations, each up to 2 m wide. Quartz-carbonate veins up to 20 cm wide fill a tension gash cleavage trending 245° to 250°. Sulphide distribution is erratic and up to 30% in the iron formations. Arsenopyrite, pyrrhotite, pyrite and minor chalcopyrite are present.

The following (Table 6.2) are assay results from grab samples from the 4 occurrences (Resident Geologist's Files, Beardmore– Geraldton District, Thunder Bay):

Table 6.2. Assay values for the Maki occurrences.

(1) Moosehorn, L20 west and L20 extension occurrence

Sample No.	Description	Au (oz./ton)
90-MNM-7	L-20: Arsenopyrite in a sheared mafic metavolcanic	0.017
90-MNM-8	L-20: Quartz vein - galena	0.443
90-MNM-9	L-20: Quartz vein	0.044
90-MNM-10	L-20 Extension: quartz, chalcopyrite	nil
90-MNM-11	L-20 Extension: quartz, chalcopyrite, pyrite	nil
90-MNM-12	L-20 Extension: quartz, sheared mafic metavolcanics	nil
90-MNM-15	L-20 Moosehorn Area: interflows metasediments	nil
90-MNM-16	Moosehorn: quartz	0.961

(2) KM vein and IF occurrence

Sample No.	Description	Au (oz./ton)
90-MNM-3	KM: 1 + 80S	0.545
90-MNM-4	KM Vein + IF	0.008
90-MNM-5	KM Vein + IF	0.002
90-MNM-6	KM: West End	trace (<0.001)

(3) L11 occurrence

Sample No.	Au (oz./ton)
90-MNM-2	0.162

(4) AM zone

Sample No.	Description	Au (oz./ton)
91-MNM-2	L3 + 00W, 0 + 35N	nil
91-MNM-3	L3 + 75W, 0 + 35N	.008
91-MNM-4	L4 + 40W, 0 + 35N (bottom)	.108
91-MNM-5	L4 + 40, 0 + 35N (south)	trace (<0.001)

STURGEON BRIDGE OCCURRENCE

The Sturgeon Bridge property is located in north-central Legault Township, immediately north of Partridge Lake (49°43′ 87°23′, 42E/11) and east of the Kinghorn Road. The 16 claim group is accessible by driving 7 km east of Jellicoe on Highway 11 to the Kinghorn Road and north for 5.7 km to the Canadian National Railway. From a road accessible ballast pit on the east side of the road, the main gold occurrence in the southern portion of the property (claims TB 813418, 813420 and TB 1082429) can be reached on foot. Extensive backhoe stripping, trenching, detailed sampling, and magnetometer and VLF-EM surveys were completed by prospectors F. Checkley and B. Nelson. Work was done under grants from the 1991 Ontario Prospectors Assistance Program (OPAP).

Oro Plata Mining Corporation Limited was the first to complete magnetic and electrical surveys in 1937 along the southern portion of the property. An apparent fault and three zones of high conductivity were discovered but no follow-up was reported. In 1955, R.W. Potter drilled 359 m in 3 holes on a claim group roughly covering the present-day ground. Sheared pyritic metavolcanics with quartz stringers and chalcopyrite were reported. By far, the bulk of the exploration work was done during the 1980s. Dome Exploration (Canada) Limited (Woodard 1980) completed an extensive ground EM and magnetometer survey in 1980 over a large claim block stretching from Oxaline Lake in the west to Partridge Lake in the east. A strong EM conductor was detected along the southern portion of the Sturgeon Bridge claims and subsequently recommended for drilling. From 1986 to 1988, Mingold Resources Inc. conducted detailed exploration work over two large claim blocks to the north and south of the Sturgeon Bridge property. Ground geophysical surveys, extensive stripping, trenching and sampling and eight diamond-drill holes totalling 1036 m were completed (Nelson 1989a, 1989b). Drill logs indicated sheared and silicified zones in volcanoclastic rocks with low gold values (Resident Geologist's files, Beardmore–Geraldton District, Thunder Bay). A detailed ground geophysical survey conducted by the property owners (Walker 1991) during the 1991 season indicates a coincident VLF-EM conductor and mineralized alteration zone.

The Sturgeon Bridge property is located in the central portion of the main Beardmore–Geraldton metavolcanic-metasedimentary belt. It lies entirely within mafic to intermediate metavolcanic rocks just south of the eastern extension of the Paint Lake fault. Intensely sheared polymictic conglomerate in the Vezina Lake area, to the north, indicates the close proximity of the Sturgeon Bridge occurrence to this major transcurrent fault. The main zone, where much of this year's work has been conducted, strikes 240° approximately and varies in width from 6 to 23 m along a 490 m strike length. Much of the recent activity is concentrated on the eastern (claim TB 813420 and 1082429) and central portions (TB 813418) of this zone. The property geology consists of rusty, highly silicified, grey to dark green mafic metavolcanic host rocks crosscut by a series of east-trending quartz-breccia veins. The metavolcanic host rocks become almost cherty from intense silicification in places and typically contain 1% very fine, disseminated pyrite. On the eastern portion of the zone, the quartz is grey, recrystallized, associated with calcite, and exhibits a strong crack-seal texture. Rare sulphide mineralization occurs within the quartz. At one point along a 48 m north-trending trench, visible gold was found within brecciated portions of the quartz veins. A second stripped location (24 by 30 m), approximately 366 m to the west along strike, exhibits intense shearing with minor folding. Quartz typically occurs as darker coloured veinlets with 1 to 2% very fine, disseminated pyrite. Seams, 1 cm in size, of massive pyrite together with chalcopyrite and malachite stain were also noted. Approximately 240 m north of this site, a second possibly parallel zone exists. Altered and highly sheared mafic metavolcanic rocks contain fragmented quartz vein material and highly contorted veinlets of quartz. Prominent patches of chalcopyrite were observed throughout the zone which appears to be over 10 m in width.

One area of intense alteration should be noted. At the north end of the eastern exposure within the main zone, a prominent gossan has developed. The metavolcanic host rock is intensely altered to chlorite and garnet and contains 0.5 to 1 cm sized broken lenses of massive pyrite and quartz-vein fragments.

Grab and chip samples collected along strike and across the main zone from the Sturgeon Bridge occurrence returned gold assays up to 0.58 and 0.74 ounce Au per ton. An anomalous zinc result of 1045 ppm was also obtained from a gossan zone in the eastern exposure (Resident Geologist's files, Beardmore–Geraldton District, Thunder Bay).

GUSTAFSON PROPERTY

The Gustafson property is located in northeastern Eva Township approximately 8 km northwest of Beardmore. The property is accessible by travelling 10.5 km west on Highway 580 from the Highway 11 junction. A well-marked north-trending trail from this point leads to the southern portion of the claim group, along the north shore of Eva Lake. Prospector H. Goodman Jr. of Beardmore staked a 15 claim group in 1990 which comprises the present day property. Prospecting, extensive stripping, trenching and detailed sampling were completed under 1990 and 1991 Ontario Prospectors Assistance Program (OPAP) grants.

Previous work was initiated by T.A. Gustafson in 1948 over a 19 claim block with the discovery of silver north of Eva Lake. Grab samples collected at this time assayed up to 13.81 ounces Ag per ton and 0.08 ounce Au per ton (Canadian Mining Journal 1949). In 1961, prospectors B. Jensen and H. Cross completed four diamond-drill holes for a total of 421 m on what was known as the Jensen Option. In 1971, Meridian Mining and Exploration Co. Ltd. drilled an additional two holes, totalling 124 m, over the original Gustafson silver occurrence (Bowdidge 1971). Both parties indicated pervasive carbonatization over long sections of drill core. Detailed sampling completed by T.A. Gustafson for Meridian Mining and Exploration Co. Ltd. (1971) delineated two main areas of significant mineralization: Zone A at 25.87 ounces Ag per ton along 12 m and Zone B at 20.50

ounces Ag per ton along 1.8 m. Extensive geophysical surveys were conducted in 1987 by San Paulo Explorations Inc. (Gledhill 1987) over a large 87 claim block covering the area north of Eva Lake, including the Gustafson showing. Magnetometer, VLF-EM and HLEM were done over a 160 km grid (assessment files, Resident Geologist's office, Beardmore–Geraldton District, Thunder Bay).

In the summer of 1990, the Ontario Geological Survey conducted a detailed mapping program covering both Summers and Eva townships (Shanks 1990).

The Gustafson property is located in the northwestern portion of the main Beardmore–Geraldton belt (Mackasey 1970). It lies entirely within mafic to intermediate metavolcanic rocks just north of the east-northeast-trending Sandy Creek Fault (Shanks 1990). Extensive stripping was performed in two main areas to expose mineralized zones within the claim group. Much of the work, including detailed sampling, was concentrated on claims TB 1148385 and 1148386 in the central portion of the group over a high relief body of rock. This feature is roughly 500 by 800 m in dimension and is described by Shanks (1990) as:

> ...a body of feldspar porphyry forming a topographic dome. Locally brecciated the rocks are highly carbonatized and silicified and contain disseminated fine-grained pyrite. Euhedral feldspar phenocrysts (<2 mm) are set in a fine grained groundmass of anhedral feldspar, sericite and carbonate rhombs.

The original Gustafson silver occurrence is located along the southeastern "rim" of this felsic body. Stripping at this location has revealed pervasive pink to red hematite alteration and green malachite stain within a pink, highly silicified feldspar porphyry. Brecciated quartz veins and veinlets up to 3 cm wide are associated with thin seams, disseminations and patches of very fine pyrite with subsidiary chalcopyrite and a fine-grained, grey metallic mineral, likely argentite. Sulphide content ranges up to 3%. A 30 m wide north-trending diabase dike transects the feldspar porphyry dome east of the main occurrence. A 1970 report by the Meridian Mining and Exploration Co. Ltd. states:

> The most important feature of the property (the Gustafson property) is the highly carbonatized, sheared, locally cherty, alteration zone which has been found to occur in an area about 1000 feet in diameter straddling the diabase dike...It is questioned whether it represents regional metamorphism since such alteration has not been reported elsewhere in the area.

The extent and nature of this locally pervasive alteration is yet to be fully explored on the property as is stated in the Meridian report (assessment files, Resident Geologist's office, Beardmore–Geraldton District, Thunder Bay).

Along the northwestern portion of the property, a second area has undergone extensive examination. Lying roughly in a northeast trend and striking 065° two sulphide mineralized occurrences were uncovered. Exposed is a highly gossaned and folded sulphide magnetite isron formation containing recrystallized fine-grained to cherty quartz-vein material. The unit is highly fractured with pervasive hematite alteration in places and discontinuous 2 to 3 mm seams of specular hematite. Pyrite ranges up to 10% and occurs as fine disseminations, coarse euhedral patches and massive seams from 1 to 2 cm thick. The surrounding wall rocks consist of sheared, carbonatized and silicified mafic to intermediate metavolcanic flows, occasionally amygdaloidal and tuffs. Minor fine disseminated pyrite up to 1% and green chloritic alteration were noted within the wall rock.

Samples collected by the claim holder and the author over the main occurrence within the felsic dome assayed up to .05 ounce Au per ton and 5400 ppm zinc (H. Goodman Jr., Prospector, personal communication, 1991).

Onaman–Tashota Belt

THE LARSON OCCURRENCE

The Larson occurrence is located in the northeast portion of Rickaby Township, immediately northwest of Atigogama Lake and southwest of Dilla (Dillabough) Lake. The property is accessible by vehicle via the Kinghorn Road, a distance of 20 km from the Highway 11 junction, and then on foot via a trapper's trail/claim-line route to the main trenches. The Larson occurrence was rediscovered by F. and P. Houghton, Beardmore, Ontario, in 1991 after indepth historical research of exploration data and reports. The Houghtons hold 55 claim units. Sampling and geochemical analyses were funded by the Ontario Prospectors Assistance Program. Consolidated Gold Hawk Resources Inc. and Hemlo Gold Mines Inc. optioned the property as a joint venture in late 1991. Line cutting and ground geophysical surveys including induced polarization (IP) have subsequently been performed.

The Larson occurrence was first described by Burwash (1933):

> These claims staked by Larson to the west of Atigogama Lake have a well sheared and superficially weathered zone in the granite which carries finely divided molybdenite and molybdenum ochre. The molybdenite is in cracks in the quartz which fills the interstices between granite fragments in a crushed zone. The best part of this vein is said to carry values of $4.60 in gold over a width of 15 inches. (Note: in 1933, gold was valued at $28.94 per ounce).

Claim TB 11113, which covers a portion of the main zone, was staked by L. Almquist for J.A. Moore in 1933. The Kenty Brothers Prospecting Company Ltd. and J. Kenty conducted assessment work, including trenching, on the property (1935 to 1937). In late 1937, all interest was transferred to C. Griffiths who worked the Larson occurrence from 1939 to 1942 and 1951 to 1955. Sturgeon Basin Mines Ltd. optioned the Larson occurrence from W. Huston in 1960 and conducted trenching (eight trenches), geological mapping and diamond drilling (three drill holes) (Resident Geologist's Files, Beardmore–Geraldton District, Thunder Bay). The occurrence remained idle and undiscovered until 1989 when A. Speed and S. Craig reported old trenches and gold assays from grab samples up to 0.123 ounce Au per ton (Speed, A. and Craig, S., in press, Beardmore–Geraldton Historical Research Project; Ontario Geological Survey, Open File Report).

The Larson occurrence is hosted by the Kaby Lake stock, massive granodiorite to trondhjemite, with local granite and quartz monzonite (Mackasey and Wallace 1978). Late mafic metavolcanic and dioritic dikes intrude the granodiorite to trondhjemite rocks within two distinct fracture sets: 1) northwest trending and 2) north to northeast trending (Quon 1960).

The Larson occurrence is exposed in seven large trenches that crosscut a northwest-trending (135° to 140°), brittle fracture system. Silification, carbonatization and potassic alteration are present. Pyrite mineralization ranging from 2 to 10%, with minor chalcopyrite and molybdenite, were observed across 30 m and for a minimum strike length of 240 m. Surface sampling from one old trench across a portion of the Larson zone by Hemlo Gold Mines Inc.–Consolidated Gold Hawk Resources Inc. returned 0.06 ounce Au per ton over 20 m (*The Northern Miner*, October 14, 1991).

ROYAL CROWN OCCURRENCE

The Royal Crown occurrence is located 5.0 km northeast of Redmond Station on the Canadian National Railway in southern Gzowski Township. The property is easily reached by train from Nakina, Ontario and travelling approximately 80 km westward. Situated just west of the McFarlane–Manion property (Mason et al. 1988, 1990) on claims TB 1188497 and TB 1145197, 2 Hornepayne prospectors, G. Milks and C. Paul, uncovered six mineralized gossan zones during the 1991 field season (Figure 6.4). Stripping and blasting followed by detailed sampling have been completed to date.

From 1915, when the McFarlane–Manion shaft was sunk (Hopkins 1917), until the rediscovery of the old workings by prospectors G. Milk and C. Paul in 1989, little work was done in the immediate area. The Polpond Mining Co. completed 73 m of diamond drilling in 1959 just south of the Canadian National Railway, approximately 1 km southeast of the McFarlane–Manion claim block. No assays were reported in the assessment files. In 1971, Caravelle Mines Ltd. completed two diamond-drill holes for a total of 335 feet on a three-claim property 0.5 km southwest of the main Royal Crown occurrence (TB 1188497). Drill-core logs indicate the presence of rhyolite porphyry and fragments, amphibolites and garnets with substantial disseminations, seams and blebs of pyrite and pyrrhotite. Again, no gold or base-metal assays of drill-core sections were reported (assessment files, Resident Geologist's office, Beardmore–Geraldton District, Thunder Bay).

The last complete detailed mapping program conducted covering the area was done by Kindle (1932). Amukun (1977, 1979), who mapped the adjacent areas to the south and west, suggests that the Royal Crown property lies entirely within a felsic metavolcanic sequence near the eastern contact of the Gzowski Lake stock. This felsic sequence is part of the northern portion of the Onaman–Tashota metavolcanic belt. Initial hand stripping by the owners at the main occurrence known as Royal Crown Occurrence No. 1 (claim TB 1188497) indicates the presence of four gossan zones separated by overburden and occurring over a width of approximately 107 m. Much of the stripping, blasting and sampling has been concentrated on what is known as Gossan No. 2 in the southeastern portion of the claim. At this location, an area of roughly 15 by 50 m has been cleared and trenched where the highest concentration of mineralization occurs. The rock consists of rusty, massive to sheared, quartz-eye porphyritic rhyolite containing 1 to 3% pervasive fine-disseminations of sphalerite, pyrite and pyrrhotite. In places, the sphalerite exists as massive seams up to 0.5 cm and as euhedral crystals from 5 to 7 mm in size. Chalcopyrite also occurs as coarse patches up to 1 cm in size. Two directions of shearing were noted in outcrop, the main shear at 280° and a secondary shear at 204°. Intense weathering to a depth of 0.3 m was observed in places throughout the exposure.

Since the initial occurrence was visited in July 1991, two additional mineralized showings have been located by the present owners. Traversing west along strike (280°) in the southern portion of claim block TB 1145197 for approximately 240 m, a second gossan exposure (Royal Crown Occurrence No.2) of roughly 107 by 200 m in size was discovered. Located a further 450 m to the west, a third, smaller (20 by 30 m), gossan zone (Royal Crown Occurrence No.3) was uncovered. Both locations contain similar sulphide and zinc mineralization as that described in Royal Crown Occurrence No. 1 (G. Milks, Prospector, personal communication, 1991).

Grab and chip samples collected by both the property owners and authors have returned zinc values as high as 9.99% and lead results up to 1.91% (Resident Geologist's files, Beardmore–Geraldton District, Thunder Bay).

It is important to note that the recent base-metal discovery at the Royal Crown property and the general lack of mineral exploration in the area makes this felsic pyroclastic package of rocks an excellent target for volcanogenic massive sulphide-type deposits. In particular, the region east of Gzowski Lake (50°15′, 87°32′, 42L/5) and south of the Canadian National Railway should be looked at in detail.

RECOMMENDATIONS FOR EXPLORATION

The Onaman Lake area should be re-evaluated as a polymetallic target area. Previously discovered volcanogenic massive sulphide prospects and remobilized shear zone, vein or breccia sulphide prospects can be highly anomalous in silver and gold. The base-metal/precious-metal theme is further reinforced by the fact that the Tashota–Nipigon gold mine, the only producer in the area, was a copper-gold-silver producer.

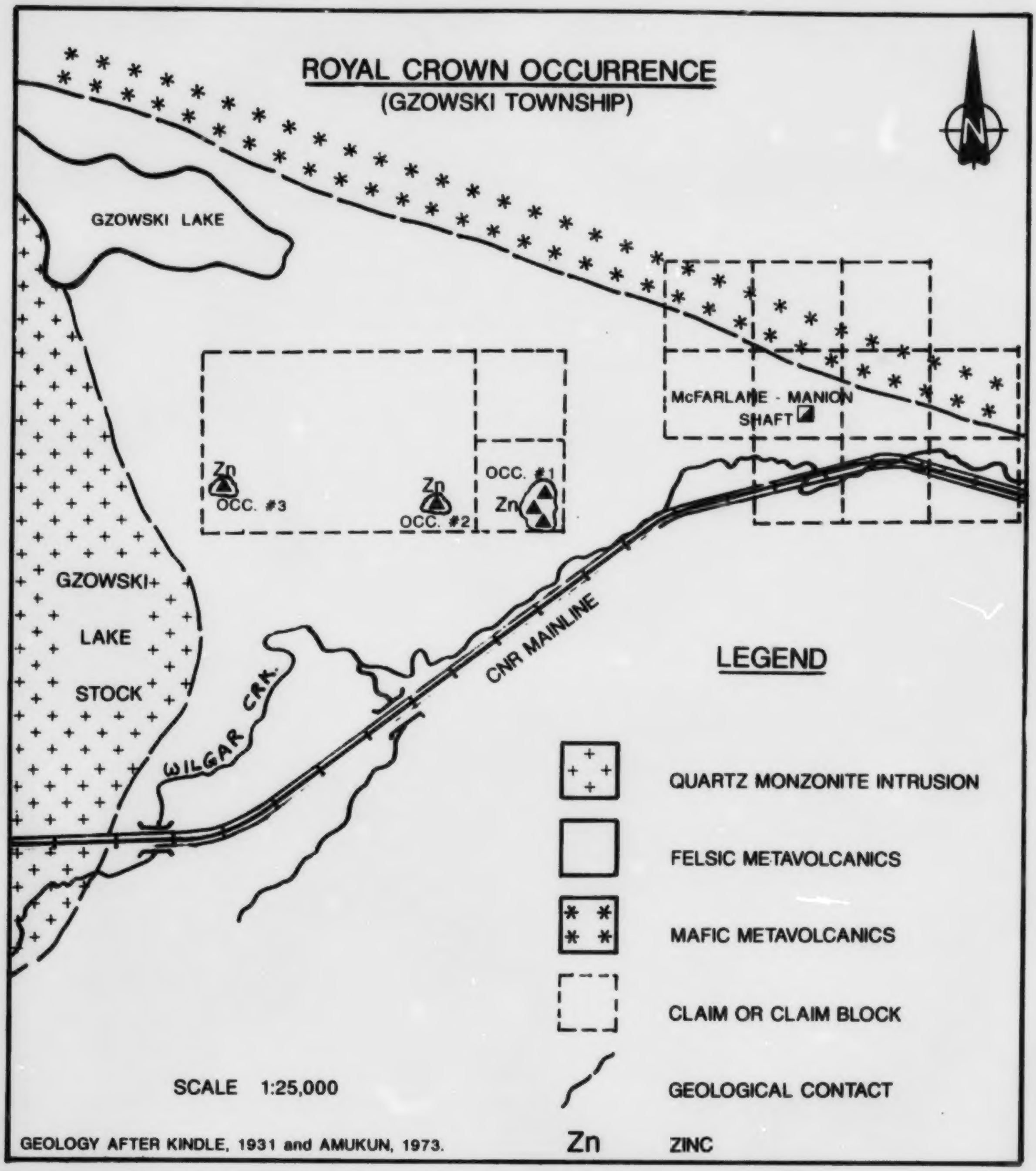

ROYAL CROWN OCCURRENCE
(GZOWSKI TOWNSHIP)
N
GZOWSKI LAKE
GZOWSKI LAKE STOCK
McFARLANE - MANION SHAFT
Zn
OCC. #3
Zn
OCC. #2
OCC. #1
Zn
WILGAR CRK.
CNR MAINLINE
LEGEND
QUARTZ MONZONITE INTRUSION
FELSIC METAVOLCANICS
MAFIC METAVOLCANICS
CLAIM OR CLAIM BLOCK
GEOLOGICAL CONTACT
Zn
ZINC
SCALE 1:25,000
GEOLOGY AFTER KINDLE, 1931 and AMUKUN, 1973.

Figure 6.4. Detailed Map of the Royal Crown Occurrence.

The Tashota–Kowkash area is a potential area for lithogeochemistry and reconnaissance base-metal prospecting. The discovery of new zinc occurrences, such as the Royal Crown in Gzowski Township in felsic metavolcanic rocks, suggests further exploration is warranted.

Fault-generated feldspar-porphyry and gabbro intrusive rocks should be explored on the main Beardmore–Geraldton belt. Gold can be associated with disseminated pyrite and arsenopyrite and/or stockwork-vein systems within the intrusions. Examples of these fault-generated intrusions include the MacLeod–Cockshutt Mine albite porphyry and the Talmora gold mine gabbro, both situated near Geraldton. The west and central portions of the Beardmore–Geraldton belt should therefore be re-examined following the guidelines of this metallogenic model. As the youngest host lithology to gold, these late tectonic intrusions define the maximum relative age of mineralization.

With respect to stripping and diamond drilling at a property scale, as in many Archean gold situations, mineralized zones are often elongate and plunging. Mineralized zones plunge parallel to the stretch lineation or to an intersection lineation. Also, careful documentation of the mineralogy and alteration may present a guide to mineralization in a stripping and/or drill program (Colvine et al. 1988).

Intensified exploration for gold is recommended on the main Beardmore–Geraldton belt, specifically on the Paint Lake fault trend from the Brookbank deposit east to the Partridge Lake area. Silicification, carbonatization, pyrite and arsenopyrite can be associated with gold mineralization.

One observation that bears reinforcement: research of assessment files, historical newspaper clippings and mineral-deposit files plus thorough field investigations often equate to the discovery (rediscovery) of gold occurrences.

ACKNOWLEDGMENTS

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7. Schreiber–Hemlo Resident Geologist's District—1991

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INTRODUCTION

The Schreiber–Hemlo District covers an area from the Nipigon River east to White River, and from the US–Canada border north to Upper Roslyn Lake and Kagiano Lake (*see* Figure 7.1). The area includes the communities of Rossport, Schreiber, Terrace Bay, Marathon, Heron Bay and Manitouwadge as well as Pic Heron Reserve No.50, Pic Mobert Reserve No.82, Pays Plat Reserve No.51 and Lake Helen Reserve No.53A. The district is adjacent to the communities of Nipigon and White River. There are presently five producing mines in the district which host the Schreiber—Winston Lake, Hemlo and Manitouwadge mining camps. The David Bell Mine of Teck–Corona Operating Corporation, Golden Giant Mine of Hemlo Gold Mines Inc. and Williams Mine of Williams Operating Corporation are the gold mines at Hemlo. The base-metal mines include the Noranda Inc., Geco Division Mine in Manitouwadge and the Minnova Inc., Winston Lake Division Mine located northwest of Schreiber.

Mining highlights in 1991 include the production of over 1.25 million ounces of gold from the Hemlo mines, representing approximately 50% of Ontario's gold production and 23% of Canada's total gold production. The Hemlo gold mines were the top three gold producers in Canada in 1990 and 1991, and all three mines rank within the top 15 gold producers in the world. In 1990 and likely again in 1991, the Williams Mine was Canada's top gold producer, producing 590 000 ounces of gold in 1990 and a projected 520 000 ounces of gold in 1991. The David Bell Mine was again one of Canada's largest and highest-grade producing gold mines, producing at a grade of 0.628 ounce Au per tonne (P. Desautels, David Bell Mine, personal communication, 1992). The Hemlo mines are some of the lowest-cost gold producers in the world. The Golden Giant Mine produced in the third quarter of 1991 at an average operating cost of US$ 108 per ounce (*The Northern Miner*, November 18, 1991, p.1).

The Geco Division of Noranda Inc. continued into its thirty-fifth year of continuous base-metal production while the Winston Lake Division of Minnova Inc. continued into its fourth consecutive year of base-metal production.

Exploration activity in the Schreiber–Hemlo District decreased once again in 1991. The total number of active exploration programs in 1991 was 59, down from the 1990 figure of 75. Due to the fact that the Ministry of Natural Resources is making it mandatory for prospectors and companies to get work permits, more of these exploration programs are now being recorded. In previous years numerous, small, prospector-based exploration programs could have been omitted. Even with the addition of the prospector programs in 1991, the total number of exploration programs dropped. In 1991, there were 29 exploration programs carried out by prospectors and 27 exploration programs carried out by major companies. This leaves only three programs carried out or joint-ventured by junior exploration companies, reflecting the lack of junior-based activity, only one of the many problems facing the mining and exploration industry today. In addition, the Noranda Group (including Geco Division, Noranda Inc., Hemlo Gold Mines Inc. and Noranda Exploration Company Limited) were active with 17 exploration programs in the Schreiber–Hemlo District, roughly two-thirds of the exploration programs by major companies. Geco Division (Noranda Inc.) and Noranda Exploration Company Limited remained active in the Manitouwadge area, committed to exploring for new and additional reserves. Present reserves at the Geco Division Mine give the mine a life expectancy of five years (H. Lockwood, Geco Division, personal communication, 1991).

Minnova Inc. continued its deep diamond-drilling program on the Pick Lake deposit, located 1.5 km southwest of the Winston Lake headframe. Published geological reserves are listed at 1.6 million tonnes at a grade of 1.1% Cu and 17.7% Zn in the upper and lower zones (*The Northern Miner*, November 18, 1991, p.3).

Approximately 1200 inquiries from the exploration and mining sector as well as the general public were dealt with by the Schreiber–Hemlo program at the Thunder Bay office, Marathon field office and in the field. This number represents an approximate 10% drop from 1990, again reflecting the present recession in the exploration and mining industry. Fifty-three property visits and nine field trips were conducted in 1991. The Ontario Prospectors Assistance Program (OPAP) designated $217 523 to 23 applicants working in the Schreiber–Hemlo District. The Ontario Mineral Incentive Program (OMIP) designated $495 546 towards five exploration programs. Several new and interesting occurrences were discovered and explored by prospectors. The W3 (Extension) vein near Schreiber was prospected by W. Acker

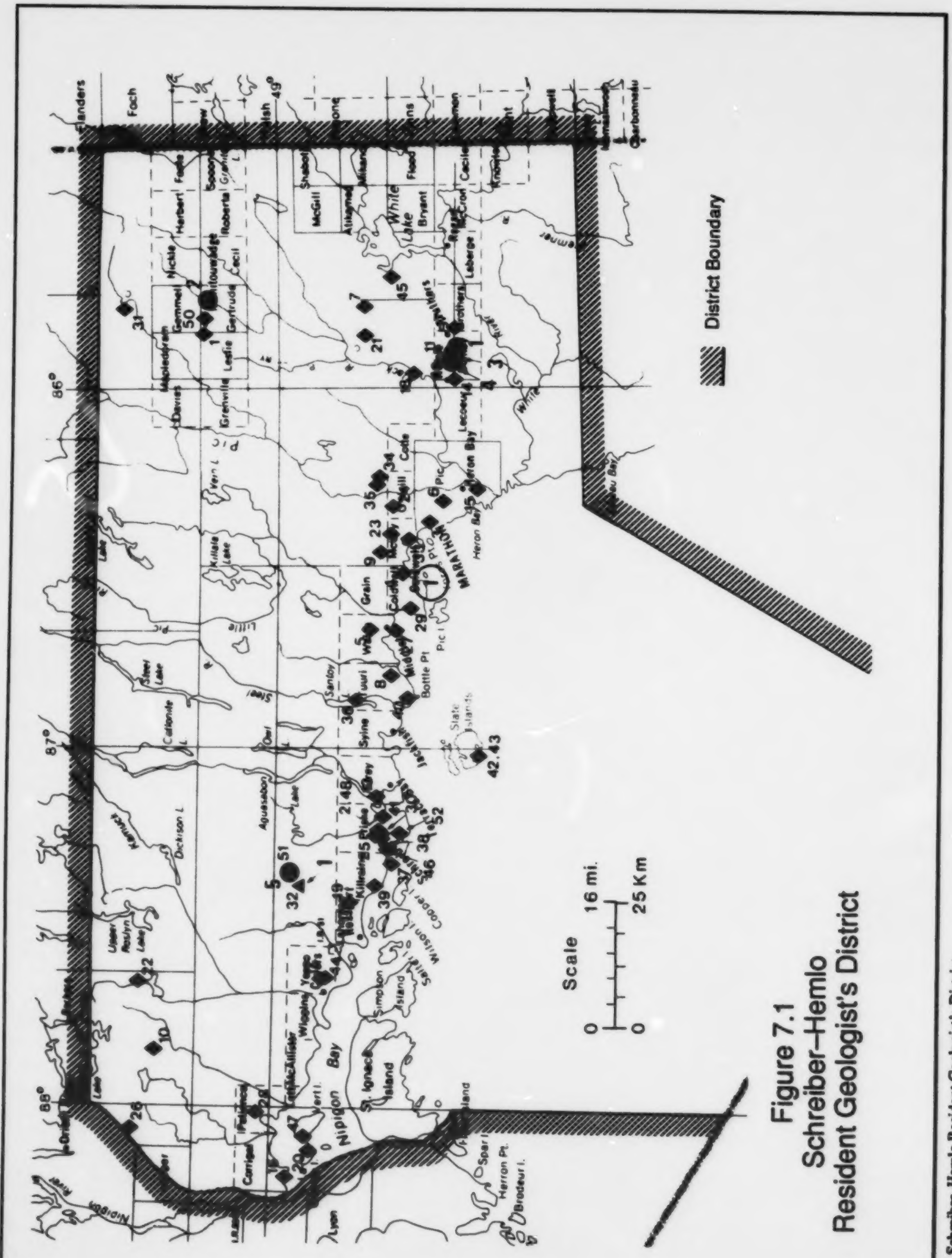
Figure 7.1
Schreiber–Hemlo
Resident Geologist's District
Scale
0
16 mi.
0
25 Km
District Boundary
88°
87°
86°
49°
Nipigon
Bay
St. Ignace
Island
Simpson
Island
Nipigon
Lake
Killala
Lake
Steel
Lake
Cairngorm L
Dickison L
Aguasabon
White
Lake
Pic
Little Pic
Heron Bay
Marathon
Bottle Pt
Slate Islands
Foch
Flanders
Carbonneau
Pic I
Wilson I
Copper I
Spar I
Herron Pt.
Brodeur I.
Davies
Grenville
Leslie
Gertrude
Cecil
Gemmell
Nickle
Herbert
Roberta
Willowridge
McGill
Shabotik
Abigail
Bryant
Flood
Leberge
Lecours
Cote
Grain
Syine
Strey
Santoy
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Figure 7.1. Schreiber–Hemlo Resident Geologist's District.

Figure 7.1.
Schreiber–Hemlo Resident Geologist's District.

EXPLANATION

● Producing Mines, 1991

1. David Bell Mine, Teck–Corona Operating Corporation
2. Geco Division, Noranda Inc.
3. Golden Giant Mine, Hemlo Gold Mines Inc.
4. Williams Mine, Williams Operating Corporation
5. Winston Lake Division, Minnova Inc.

Properties under Evaluation

▲ Pick Lake Deposit, Minnova Inc.

◆ Property Visits, 1991 (keyed to Table 7.3)

Location of OGS Field Party in 1991

① Geology of the Coldwell alkaline complex,
R.H. Sutcliffe et al.

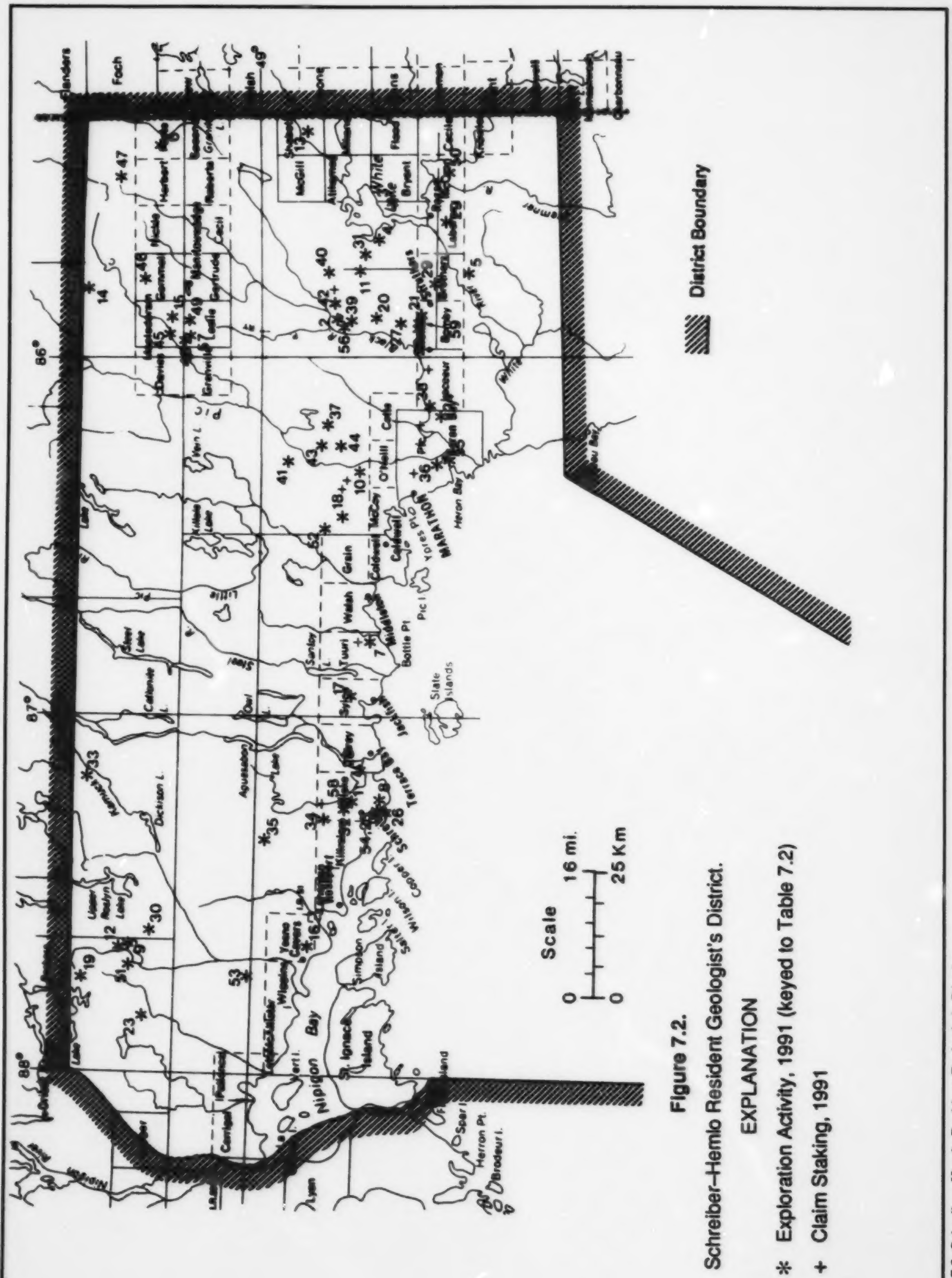
88°
87°
86°
Nipigon Bay
St. Ignace Island
Simpson Island
Bottle Pt.
Pic I.
Slate Islands
MARATHON
Heron Bay
Scale
0
16 mi.
0
25 Km
District Boundary
Dickison L.
Aguasabon
Manitouwadge
Herron Pt.
Foch

Figure 7.2.

Schreiber–Hemlo Resident Geologist's District.

EXPLANATION

- * Exploration Activity, 1991 (keyed to Table 7.2)
- + Claim Staking, 1991

Figure 7.2. Schreiber–Hemlo Resident Geologist's District.

and R. Otto. The Singleton–Gray occurrence was rediscovered after 50 years by M. Joa. Gold-bearing porphyries in the Worthington Bay area were investigated by J. Courtney and G. Daniels. Sericite schists with anomalous gold values and green mica-bearing fragmental rocks in the Armand Lake (White Lake) area were discovered by B. Fowler and M. Shuman. Copper occurrences in the Theresa Lake area were discovered by J. Martin and C. Bumbu.

ACKNOWLEDGMENTS

Technical support and assistance for this report were provided by S. Warren who prepared assessment file data. C. Komar provided typing and word-processing support. K. Fenwick and M. Grant reviewed and edited the manuscript.

As always, numerous prospectors, geologists and individuals from the exploration and mining sector provided valuable information and discussion throughout 1991 and many are referred to throughout the text.

All analytical work reported, unless otherwise noted, was performed by Temiskaming Testing Laboratory, Ministry of Northern Development and Mines, Cobalt and Geoscience Laboratories Section, Ontario Geological Survey, Toronto.

MINING ACTIVITY

Geco Division (Noranda Inc.)

Production from the Geco Division Mine, Manitouwadge, from July 1, 1990 to July 1, 1991, involved milling 1 315 300 tons (short) of ore at a grade of 1.64% Cu, 3.61% Zn and 1.33 ounces Ag per ton (H. Lockwood, Geco Division, personal communication, 1991).

The estimated production from January 1, 1991 to January 1, 1992 is 1 382 000 tons (short) of ore at a grade of 1.32% Cu, 3.73% Zn and 1.22 ounces Ag per ton (H. Lockwood, Geco Division, personal communication, 1991).

The mineral inventory as of July 1, 1991 is listed at 6 745 000 tons (short) at 1.69% Cu, 2.72% Zn and 1.13 ounces Ag per ton (H. Lockwood, Geco Division, personal communication, 1991).

Winston Lake Division (Minnova Inc.)

The Minnova Inc. Winston Lake Division Mine completed its fourth full year of production in 1991. Production for the period of January 1, 1991 to December 31, 1991 was 347 171 t milled at a head grade of 1.22% Cu, 16.44% Zn, 38.73 g/t Ag and 1.70 g/t Au (R. Sim, Winston Lake Division , personal communication, 1992).

Reserve estimates as of January 1, 1992 which include proven, probable, possible and potential ore with a 20% dilution at 0% grade are indicated at 1 826 597 t at a grade of 1.03% Cu, 13.78% Zn, 28.67 g/t Ag and 1.18 g/t Au (R. Sim, Winston Lake Division, personal communication, 1992) Estimated production in 1992 is 340 000 t.

HEMLO AREA MINES

David Bell Mine (Teck–Corona Operating Corporation)

Production from the David Bell Mine from January 1, 1991 through December 31, 1991 consisted of 295 284 feed ounces of gold from 470 197 t milled at a feed grade of 0.628 ounce Au per tonne (P. Desautels, David Bell Mine, personal communication, 1992).

Mineable, diluted and recoverable ore reserve estimates as of December 31, 1991 were 6 842 593 t at 0.362 ounce Au per tonne representing 2 474 160 ounces Au (P. Desautels, David Bell Mine, personal communication, 1992).

Golden Giant Mine (Hemlo Gold Mines Inc.)

Production from the Golden Giant Mine from January 1, 1991 through December 31, 1991 was 443 438 ounces Au from 1 154 677 t milled at a grade of 12.372 g/t (B. Kusins, Golden Giant Mine, personal communication, 1992). This includes milling of 910 995 t at a grade of 12.821 g/t from the Golden Giant deposit No.1 zone, 156 430 t at a grade of 15.317 g/t from the Quarter claim and 87 252 t at a grade of 2.407 g/t from the Sceptre zone.

Total ore reserve estimates as of December 31, 1990 were 16 227 000 t at a grade of 11.0 g/t (B. Kusins, Golden Giant Mine, personal communication, 1992). This figure includes tonnages from the Golden Giant deposit No.1 of 14 260 212 t at a grade of 11.06 g/t and 1 967 478 t at a grade of 10.70 g/t from the Quarter claim.

Williams Mine (Williams Operating Corporation)

Production from the Williams Mine from January 1, 1991 to December 31, 1991 was 518 703 ounces Au from 2 185 354 t milled at a grade of 0.25 ounce Au per tonne (J. Gray, Williams Mine, personal communication, 1992).

Total proven and probable diluted ore reserves for the Williams Mine as of January 1, 1992 are estimated at 31 916 000 t at a grade of 0.191 ounce Au per tonne representing 6 108 000 ounces Au (J. Gray, Williams Mine, personal communication, 1992).

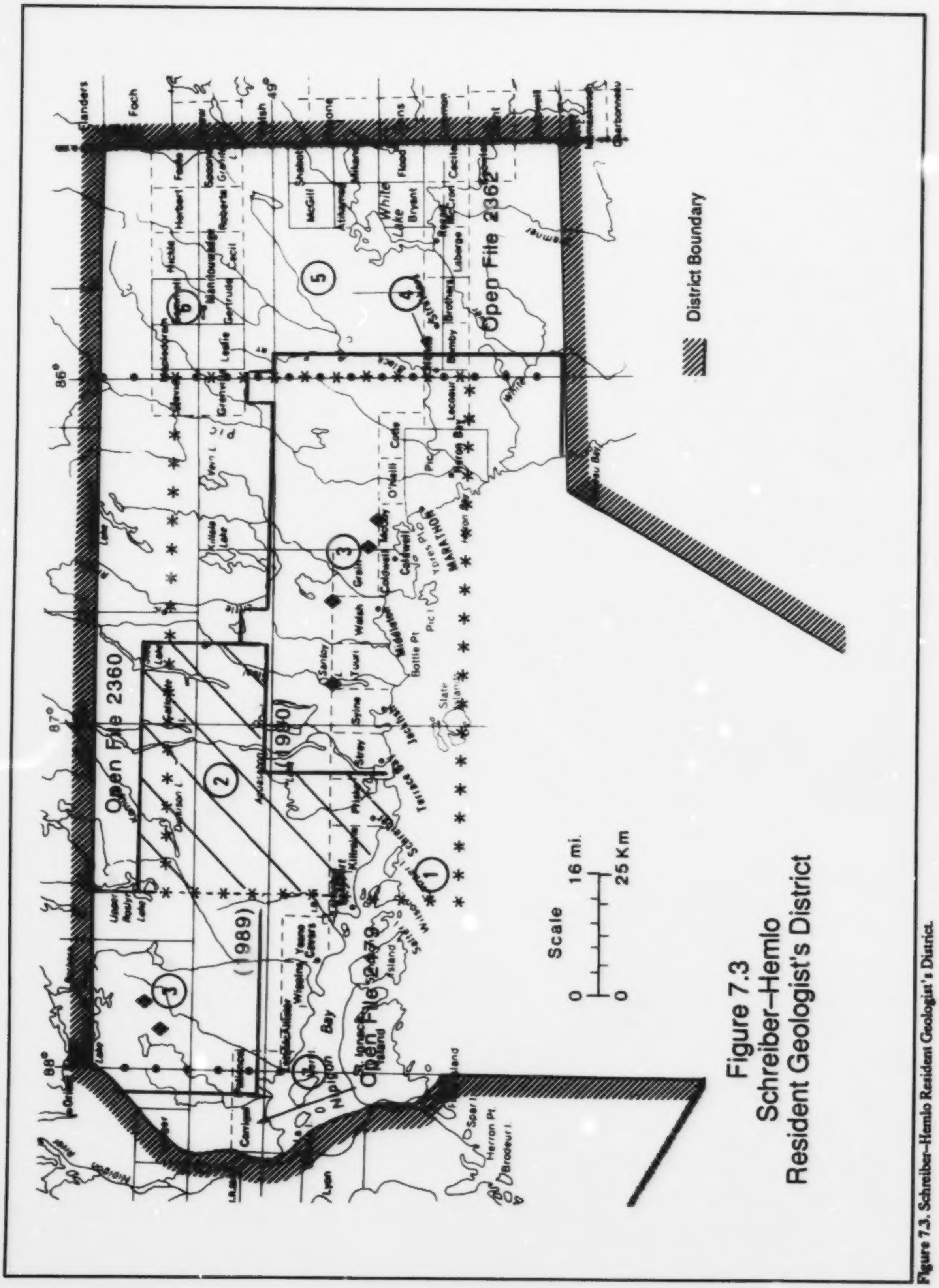
Figure 7.3
Schreiber–Hemlo
Resident Geologist's District
District Boundary
Scale
16 mi.
25 Km
0
0
Open File 2360
Open File 2362
Open File 2479
(1989)
(1990)
88°
87°
86°
49°
1
2
3
4
5
6
Nipigon
Bay
Schreiber
Terrace Bay
Jackfish
Slate Islands
Bottle Pt
Pic I
MARATHON
Ypres Pt
Heron Bay
Pic
White Lake
Foch
Flanders
Manitouwadge
Killala Lake
St. Ignace Island
Simpson Island
Herron Pt.
Brodeur I.
Lyon
Cecil
Gertrude
Leslie
Grenville
Coldwell
Caldwell
O'Neill
Cotte
Walsh
Strey
Syine
Tuuri
Sanley
Killraine
Pitch
Wiggins
Yesno
Cavers
Dublin
Arbutus
Upper Roslyn Lake
Cortigan
Lecoour
Bomby
Brothers
Laberge
Bryant
Flood
McGill
Atkinson
Mikano
Shabotik
Herbert
Roberts
Gemmell
Nickle
Foote
Cecile
McCron

Figure 7.3. Schreiber–Hemlo Resident Geologist's District.

Figure 7.3.
Schreiber–Hemlo Resident Geologist's District.

EXPLANATION

○ Location of Geological Survey of Canada Field Parties in 1991:

* * * 1. Synthetic-Aperture Radar imagery (ground follow-up), D.F. Graham, C. Bowie and K.L. Ford

◺ 2. Airborne Geophysical Survey, P.B. Holman

3. Airborne Gamma-Ray Spectrometric Survey (ground follow-up), K.L. Ford
4. Hemlo Gamma-Ray Spectrometric Survey, B.W. Charbonneau
5. Drift Geochemistry/Surficial Geology Study, I. Kettles
6. Manitouwadge Detailed Study, E. Zaleski

Related Activity

• • • 7. National Geochemical Reconnaissance Survey, Open File releases, P.W.B. Friske et al.

┘ Previous Airborne Geophysical Surveys (1989, 1990)

◆ Property Visit, 1991

TABLE 7.1. Schreiber–Hemlo Resident Geologist's District—exploration activity (expressed as percentage of programs).

COMMODITY	1987	1988	1989	1990	1991
Gold/Silver (Au, Ag)	70%	61%	45%	55%	47%
Base Metals (Cu, Zn, Ag)	14%	18%	34%	35%	38%
Platinum-Group Elements (PGE, Cu, Ni)	14%	9%	3%	3%	5%
Industrial Minerals (Building and Dimension Stone, Amethyst)	2%	12%	18%	7%	10%
Total Number of Active Exploration Programs	51	60	56	75	59

ADVANCED EXPLORATION AND DEVELOPMENT

Pick Lake Deposit (Minnova Inc.)

Minnova Inc. continued exploration in 1991 on its Pick Lake deposit located 1.5 km southwest of the Winston Lake Mine. In seven holes, 6400 m of diamond drilling (including wedging) was carried out to test the strike and downplunge extensions of the Pick Lake deposit. Geological reserves (including a 20% dilution) published for the upper zone are 400 000 t at a grade of 0.9% Cu and 14% Zn, while the lower zone is 1 200 000 t at a grade of 1.2% Cu and 19% Zn (I. Morrison, Minnova Inc., personal communication, 1991). Minnova Inc. is presently doing an economic evaluation of the Pick Lake deposit.

The Pick Lake deposit is a continuous massive sulphide sheet with a downplunge length of 1.4 km. The upper zone of the deposit occurs between vertical depths of 300 m to 700 m, while the lower zone is 850 m to 1150 m deep (I. Morrison, Minnova Inc., personal communication, 1991). The lower zone of the deposit is open along strike to the south. Further diamond drilling is planned for early 1992.

EXPLORATION ACTIVITY

Exploration activity in the Schreiber–Hemlo District decreased in 1991 compared to 1990 in terms of both the number of active programs and dollar expenditures. This decline again reflects the national exploration trend and the present recession in exploration. The number of active exploration programs in the Schreiber–Hemlo District was 59, a drop of 16 programs from 1990 (Table 7.2). The Ontario Prospectors Assistance Program (OPAP) assisted in funding 23 exploration programs. The Noranda Group (Hemlo Gold Mines Inc., Geco Division, Noranda Exploration Company Ltd.) was the most active company with 17 exploration programs, accounting for approximately 63% of the active exploration programs by major companies. 1991 again showed an increase in the number of base-metal exploration programs (Table 7.1). However, gold still remained the most sought-after commodity, representing 47% of the active exploration programs. Base metal represented 38% of the exploration programs, industrial minerals 10% and platinum-group elements (PGE, including Cu, Ni) 5% of the active exploration programs (*see* Table 7.1).

Due to the implementation of the new Mining Act, and the change from claims to claim units and from man-days to a dollar-based system, 1991 was a difficult year to assess exploration trends expressed as either the number of active claims or the amount of assessment work filed. A summary of claims recorded and assessment work for the Thunder Bay Mining Division is available in Table 5.1 Lavigne et al., this volume.

GOLD EXPLORATION

Gold is still the most sought-after commodity in the Schreiber–Hemlo District, accounting for 48% of the active exploration programs. In the Hemlo camp, major companies such as Hemlo Gold Mines Inc., Newmont Exploration Ltd. and Lac Minerals Ltd. carried out the bulk of the exploration work, while junior companies were almost non-existent.

Hemlo Gold Mines Inc. has recently acquired numerous Noranda Exploration Company Limited gold projects and still remains the most active gold exploration company in the Schreiber–Hemlo District with eight exploration programs in 1991. Exploration on both the Golden Giant orebody and the Golden Sceptre ore zone is ongoing. Deep drilling was conducted in 1991 to test for downplunge extensions of the main Golden Giant orebody. Hemlo Gold Mines Inc. was also active in the Schreiber area at the old North Shores mine property, conducting diamond drilling in 1991. The property has a history of minor production from narrow, high-grade quartz veins. However, Noranda is testing a model involving potentially larger tonnages and lower grades, with structurally controlled mineralization associated with syenite and quartz-feldspar porphyry host rocks. Further diamond drilling is scheduled for 1992.

Williams Operating Corporation explored underground from the 9175 foot level of the Williams Mine. On surface, percussion drilling was carried out over the C zone and further diamond drilling is planned for 1992.

Lac Minerals Ltd. continued exploration drilling on its White River prospect in Bomby, Brothers and Laberge townships in 1991.

Newmont Exploration Ltd. was active on three exploration programs in the Hemlo area. Line cutting, geological mapping, geophysical and geochemical surveys and reverse-circulation drilling were conducted in 1991. Diamond drilling is planned for 1992.

V. Stenlund of Stenlund Resources Ltd. continued diamond drilling on the Heron Bay Mine property (includes the former Peekongay, Bowhill mines, Lytton Minerals and Stenlund properties). A previous option with Golden Myra Resources Inc. terminated in January 1991. Drilling intersected quartz-feldspar-porphyritic rocks up to 100 m in width with the contacts displaying sericitic, pyritic and potassic and/or hematitic alteration and several zones containing green mica slips up to 2.5 cm in length. Initial sampling and analyses by V. Stenlund returned one 2 m section assaying 0.05 ounce Au per ton (V. Stenlund, Prospector, personal communication, 1991). While no ore-grade intersections were encountered in the 1991 drilling, many zones are anomalous in gold and warrant further exploration. The surface outcrops display evidence of tight isoclinal folding and strongly developed foliation striking 65° to 80° with mineral lineations plunging from 30° to 40° to the west.

Prospectors B. Fowler and M. Shuman discovered quartz-porphyritic rocks, sericite schists and green mica-bearing fragmental rocks in the Armand Lake area, approximately 5 km west of White Lake. Analytical values up to 0.08 ounce Au per ton have been recorded and the prospectors plan a more extensive stripping, trenching and sampling program in 1992.

Prospectors W. Acker and R. Otto continued to strip, trench and sample on the McKenna-McCann property located 3.2 km northeast of Schreiber (*see* "Property Examinations" section). Stripping in 1991 discovered the extension of the W3 vein (the W3 Extension vein) and has increased the strike length of the vein system to over 500 m. In addition, the McKenna–McCann shaft was refurbished, dewatered and preliminary sampling was carried out underground. Grab samples of over 1 ounce Au per ton were collected from underground (*see* "Property Examinations" section). In 1992, the prospectors plan to strip and trench north from the McKenna–McCann property towards the Johnston–McKenna property.

M. Joa, prospecting in the Hays Lake area, rediscovered the Singleton–Gray property, which had been thought to be flooded in the 1950s (*see* "Property Examinations" section). This rediscovery has again confirmed the greater than 5 km long strike length of gold occurrences in this area.

BASE-METAL EXPLORATION

Base-metal exploration displayed yet another increase in 1991 accounting for 38% of the active programs (*see* Table 7.1). This is the fifth straight year that base-metal exploration has displayed an upward trend and demonstrates the increased exploration activity for base metals on not only a district level, but reflects the national trend as well.

Minnova Inc. continues to be very actively involved in exploration on the Winston Lake deposit and in the Pick Lake deposit area (*see* "Advanced Exploration" section). Underground exploration from the 455 m exploration drift included diamond drilling to test for upplunge and downplunge extensions on the western lateral extension of the deposit (R. Sim, Minnova Inc., personal communication, 1991).

On the Victoria Lake property optioned from Noranda Exploration Company Limited (50%)/Cumberland Resources Ltd. (50%), 2200 m of diamond drilling in four holes was conducted. In addition, geological mapping, lithogeochemical surveys and pulse EM geophysical surveys were conducted. Minnova Inc. has further defined and extended a large alteration zone with mineral assemblages including cordierite, anthophyllite, andalusite, sillimanite and garnet. Work is continuing.

Geco Division (Noranda Inc.) and Noranda Exploration Company Limited were active in the Manitouwadge synform and surrounding area, including exploration programs based on ground follow-up of the major airborne geophysical survey flown in 1989. A total of 11 exploration programs were carried out by Geco and Noranda during 1991. For a more complete summary of exploration and prospecting in the Manitouwadge area, see "Manitouwadge Resource Geologist Program" section.

Several reconnaissance prospecting programs were carried out for copper on the Mesoproterozoic (Keweenawan) volcanic and sedimentary rocks throughout the district.

PLATINUM-GROUP ELEMENTS EXPLORATION

Exploration for the platinum-group elements (PGE + copper + nickel) remained at a low level in 1991, with only three active exploration projects. The Marathon Cu-PGE property of Fleck Resources Ltd. saw limited activity; a biogeochemical survey was carried out. G. Gionet contracted a deep EM

Table 7.2. Schreiber–Hemlo Resident Geologist's District—Exploration Activity.

ABBREVIATIONS

AEM	Airborne electromagnetic survey	IP	Induced polarization survey
AMag	Airborne magnetometer survey	Mag.	Magnetometer survey
ARad	Airborne radiometric survey	Res	Resistivity survey
DDH	Diamond-drill hole	Rad	Radiometric survey
EM	Electromagnetic survey	UG	Underground Work
HLEM	Horizontal-loop electromagnetic survey	VLF	Very low frequency electromagnetic survey

	Company/Individual(s) Exploration	Property Name	Township/Area	Work Done
1.	Acker, Walter/Otto, Russell	McKenna-McCann Property	Priske Township	power, stripping, trenching, sampling
2.	Brinklow, Lonnie	Lampson Road Property	Black River and Wabikoba Lake areas	prospecting, sampling
3.	Carroll, Daniel	White Lake Property	White Lake (North) Area	trenching
4.	Carroll, Daniel	Spruce Bay Property	White Lake (North) Area	trenching, stripping, sampling
5.	Carroll, Thomas	Jumbo Lake Property	Herrick Lake Area	trenching
6.	Chong, Albert/Myers, Chris	Ice Lake Property	Foote Township	prospecting, sampling, trenching
7.	Courtney, Jerry/aniels, George	Fire Mountain Property	Tuuri Township	trenching, sampling, prospecting
8.	Courtney, Jerry/Daniels, George	Worthington Creek Property	Priske Township	prospecting, stripping, trenching, sampling
9.	Dampier, Gerard	Kabamichigama Lake Property	Kabamichigama Lake Area	power, stripping
10.	Fleck Resources Ltd.	Marathon Property	Seeley Lake Area	biogeochemical, sampling
11.	Fowler, Brian/Shuman, Mike	Armand Lake Property	Wabikoba Lake Area	prospecting, sampling, stripping, trenching
12.	Galarneau, Ted	Little Bear Quarry	Kabamichigama Lake Area	stripping, trenching
13.	Gionet, Gilles	Shabotik Property	Shabotik Township	deep EM
14.	Goodwin, Grant/Turner, Alan	Otter Lake Property	Everest Lake Area	prospecting, sampling, stripping, trenching
15.	Granges Inc.	Central Property	Mapledoram Township	pulse EM, DDH
16.	Halonen, Lauri	Cavers Property	Yesno Township	stripping, trenching
17.	Hamel, J. Ray	Beaver Creek Property	Syine Township	prospecting, sampling, stripping
18.	Hamilton, John	Coubran Lake Property	Seeley Lake Area	trenching
19.	Hein, Harold/Thorsteinson, Ed.	Squaw Lake	Arrell Lake Area	DDH
20.	Hemlo Gold Mines Inc.	Barbara Lake Property	Wabikoba Lake Area	geological mapping, soil geochemistry
21.	Hemlo Gold Mines Inc.	Golden Giant Mine	Bomby Township	DDH
22.	Hemlo Gold Mines Inc.	Golden Sceptre Property	Bomby Township	stripping, geological mapping, sampling
23.	Hemlo Gold Mines Inc.	Glacier Creek (Kukkee) Property	Cosgrave Lake	DDH
24.	Hemlo Gold Mines Inc.	Mussy Creek (Black River) Property	Pic Township & Rous Lake Area	IP, prospecting
25.	Hemlo Gold Mines Inc.	Skalesky Property	Priske Township	geological mapping, trenching
26.	Hemlo Gold Mines Inc.	North Shores Property	Priske Township	trenching, DDH
27.	Homestake Mineral Development Company	Enterprise Property	Wabikoba Lake Area	geological mapping, prospecting

Table 7.2. Continued.

	Company/Individual(s) Exploration	Property Name	Township/Area	Work Done
28.	Joa, Melvin Property	Hays Lake	Priske Township	prospecting, sampling, stripping, trenching
29.	Lac Minerals Ltd.	White River Property	Brothers, Abraham, Bomby, Laberge & Knowles townships, Oskabukuta Lake Area	Mag, IP, DDH
30.	Laporte, Eldon	Kabamichigama Lake Property	Kabamichigama Lake Area	power stripping
31.	Martin, James/Bumbu, Costy	Theresa Lake Property	White Lake (North) Area	stripping, trenching, sampling, prospecting
32.	Mikkonen, Ray	Johnston-McKenna Property	Priske Township	sampling, test milling
33.	Minnova Inc.Property	Kamuck River Area	Kamuck River	pulse EM
34.	Minnova Inc. (Noranda/Cumberland Option)	Victoria Lake Property	Killraine & Priske townships, Pays Plat Lake Area	pulse EM, geological mapping, litho-geochemistry, DDH
35.	Minnova Inc.	Winston Lake Mine/Pick	Pays Plat Lake Area	DDH, borehole pulse EM, deep pulse EM
36.	Nabigon, Ed./Kusserow, Gunther	Pic River Property	Pic Township	line cutting, geological mapping, VLF
37.	Newmont Exploration Ltd.	Cirrus Lake Property	Loma Lake Area	lake bottom sediment geochemistry
38.	Newmont Exploration Ltd.	Hemlo West Property	Pic & Lecours townships	overburden DDH, geological mapping
39.	Newmont Exploration Ltd	Summers Lake Property	Wabikoba Lake Area	geological mapping, line cutting, Rad
40.	Noranda Exploration Company, Limited	Fairservice (Dotted Lake) Property	Black River, Olga Lake, Wabikoba Lake Areas	geological mapping, line cutting, HLEM, Mag, DDH
41.	Noranda Exploration Company, Limited	Huck Lake Property	Martinet Lake Area	HLEM, Mag, geological mapping
42.	Noranda Exploration Company, Limited	Lampson Road Property	Black River Area	line cutting, stripping, HLEM, soil geochemistry, Mag
43.	Noranda Exploration Company, Limited	Louis Lake Property	Cirrus Lake & Martinet Lake Areas	DDH
44.	Noranda Exploration Company, Limited	Page Lake Property	Seeley Lake Area	HLEM, Mag
45.	Noranda Inc.(Geco Division)	Buffalo-Canadian Prospect	Mapledoram Township	prospecting
46.	Noranda Inc.(Geco Division)	Fox Lake/Rabbitskin Property	Gemmell Township, Loken Lake Area	prospecting, sampling
47.	Noranda Inc.(Geco Division)	One Otter Lake (East) Property	Loken Lake Area	Mag, VLF, line cutting, geological mapping, stripping, rock/soil geochemistry
48.	Noranda Inc.(Geco Division)	Nama/ Swill Lake Property	Leslie & Mapledoram townships	prospecting, sampling, geological mapping
49.	Noranda Inc.(Geco Division)	Sand Lake Property	Leslie Township	prospecting, soil geochemistry
50.	Noront Resources Ltd.	Bremner River Property	McCron Township, White Lake (South) & Oskabukuta Lake Areas	VLF, (DDH planned)
51.	Paterson, Richard	Kabamichigama Lake Property	Kabamichigama Lake Area	trenching, sampling

Table 7.2. Continued.

	Company/Individual(s) Exploration	Property Name	Township/Area	Work Done
52.	Redstone Resources Inc.	Marathon Project	Seeley Lake, Martinet Lake Areas, Grain Township	line cutting, Mag, VLF, soil geochemistry, DDH
53.	Reukl, Robert	Nagunagisic Property	Gravel River, Pays Plat Lake Areas	VLF, Mag
54.	Skalesky, Don	Rooster Canyon Property	Priske Township	prospecting, sampling
55.	Stenlund Resources Ltd.	Heron Bay Property	Pic Township	DDH
56.	Turner, Albert	Pinegrove Lake Property	Wabikoba Lake & Black River Areas	prospecting, sampling, stripping
57.	Turner, Albert	Swill Lake Property	Leslie Township	prospecting, sampling, stripping, trenching
58.	Twomey, Tim	Big Duck Creek Property	Priske Township	stripping
59.	Williams Operating Corporation (Teck Corporation/International Corona Corporation)	Williams Mine	Bomby Township	DDH

geophysical survey over his Shabotik copper + nickel + platinum-group elements property in Shabotik Township.

The most significant exploration program was that of Redstone Resources Inc. who carried out line cutting, magnetometer and VLF geophysical surveys, soil geochemical surveys and diamond drilling on its Marathon project (previously known as the Head of the Lakes Iron Ltd. property and Lakehead Mines property) in the Coldwell alkalic complex.

INDUSTRIAL-MINERALS EXPLORATION

Six exploration projects for amethyst were active in the Schreiber–Hemlo District during 1991 (*see* Table 7.1 and Garland, this volume). No exploration for dimension stone, building stone or rare-earth elements occurred in 1991.

GENERAL GEOLOGY

The Schreiber–Hemlo District is underlain by Early to Late Precambrian rocks. The Archean rocks represent a portion of the Abitibi–Wawa Subprovince of the Superior structural province in contact with the Quetico Subprovince in the extreme northern section of the area. The Abitibi–Wawa Subprovince is a supracrustal metavolcanic-metasedimentary sequence which has been intruded by granitic-syenitic plutons and metagabbroic dikes and sills.

The supracrustal rocks occur in three "main" belts within the Schreiber–Hemlo District: 1) the Schreiber–Terrace Bay–Winston Lake area, previously described by Marmont (1984), Severin and Balint (1985), and Patterson et al. (1987); 2) the Cirrus Lake-Heron Bay–Hemlo area, previously described by Milne (1967), Muir (1982a, 1982b) and Patterson (1984); and 3) the Manitouwadge area, previously described by Pye (1960), Friesen et al. (1982) and Williams and Breaks (1989, 1990).

The metavolcanic rocks within the Schreiber–Hemlo District vary from calc-alkalic pyroclastic rocks, breccias, tuffs, flows, porphyritic flows, schists and gneisses to mafic, tholeiites rich in iron which include pillowed and massive flows, tuffs, schists and gneisses. The metasedimentary rocks consist of graded turbidites, wackes, mudstones, schists, paragneisses, minor conglomerates and iron formation. Sulphide-facies iron formation predominates in the Schreiber–Terrace Bay area, while oxide-silicate facies appear to predominate in the Manitouwadge area. Numerous felsic batholiths, plutons, stocks and porphyry dikes, including the Terrace Bay batholith, Heron Bay pluton and Cedar Lake pluton, intrude the supracrustal rocks. The supracrustal rocks have been metamorphosed under low-grade (greenschist facies) conditions in the Schreiber, Jackfish, Big Duck and Heron Bay areas, under medium-grade (amphibolite facies) in the Winston Lake and Hemlo areas and under medium to higher grade (upper amphibolite facies) in the Manitouwadge area.

The supracrustal rocks have undergone up to four periods of deformation (Muir and Elliot 1987). Two periods of deformation are evident in the Hemlo area, while evidence of multiple or complex folding events is present in the lower

Steel River area (Schnieders 1987). Large-scale faulting and deformation zones have been recognized in the Hemlo area by Page (1947a, 1947b, 1948, 1949), Bartley and Page (1958), Hugon (1984, 1986) and Muir and Elliot (1987); in the Big Duck Lake area by Williams (1986, 1987, 1988, 1989); and in the Jackfish–Middleton area by Williams (1987, 1989) and Schnieders (1987).

Paleoproterozoic rocks unconformably overlie the Archean rocks. The Gunflint and Rove Formation sedimentary rocks consist of conglomerate, black shale and iron formation.

Mesoproterozoic sedimentary rocks unconformably overlie the Paleoproterozoic rocks. The Sibley Group consists of conglomerate, sandstone, shale, carbonates and chert. Keweenawan rocks are represented by diabase dikes and sills, and mafic to felsic volcanic and sedimentary rocks (Osler Group) in the Nipigon Bay–Schreiber Channel area. Mesoproterozoic intrusive rocks include the Coldwell and Killala alkalic complexes and the Prairie Lake carbonatite, as well as mafic to felsic dikes.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

The Schreiber–Hemlo Resident Geologist office is staffed by B.R. Schnieders, Resident Geologist and M.C. Smyk, Staff Geologist. D.B. McKay, Resource Geologist, initiated the Manitouwadge Mineral Resource Geologist Program in January 1991, funded under the Northern Ontario Development Agreement (NODA). D.B. McKay is responsible for writing the Manitouwadge section of this report. T. Oja assisted the project during July, August and September. P. Hinz, Resource Geologist, continued as the Industrial Minerals Geologist for the Northwestern Region, with special emphasis on Manitouwadge. This program was also funded by NODA. B. Lucas assisted P. Hinz from June to the end of 1991. The Resident's office operated from the Mines and Minerals Division office in Thunder Bay. A field office was maintained at the office of the Northern Development Officer (NDO), Ministry of Northern Development and Mines in Marathon from May through October 1991. This field office operates every Tuesday afternoon between 1:00 and 5:00 p.m.

During 1991, the Schreiber–Hemlo Program dealt with approximately 1200 inquiries from the mining sector and general public, including 550 visitations and 650 phone inquiries. This figure is down approximately 10% from 1990. Included in the total were 85 visitations and 35 phone inquiries at the Marathon field office.

A total of 63 property visits to 53 separate properties were conducted in 1991, not including the Industrial Minerals or Manitouwadge programs. Three underground mine tours were attended as well as four surface mine tours. In addition, nine field trips or tours were conducted, and a field guide "Geology and Gold Deposits of the Hemlo Area" was written with T. Muir for the Geological Association of Canada/Mineralogical Association of Canada/Society of Economic Geologists (GAC/MAC/ SEG) Joint Annual Meeting in Toronto. Ten oral presentations and three poster displays were also given to various groups and organizations. The Schreiber–Hemlo program conducted a Basic Prospecting Course in Nipigon, involving 18 hours of classes. Also five Prospector Information sessions were conducted in Marathon (2), Manitouwadge (2) and Schreiber, which dealt with topics such as the OPAP Program, the new Mining Act, exploration activity and recommendations to prospectors. Several trips were made with the geologists from the University of Western Ontario under the supervision of R. Sutcliffe who is undertaking a three-year mapping program of the Coldwell alkalic complex. In addition, five conferences or seminars were attended or contributed to.

The 1991 Northwestern Ontario Mines and Minerals Symposium was organized and hosted in Thunder Bay in April 1991 and was attended by over 450 people. B.R. Schnieders and J. Scott organized the prospectors' tent in which 22 prospectors displayed maps, samples and potential properties to interested exploration companies and geologists. M.C. Smyk was involved with the concept development and production and implementation of the Mining Sequence Display. Staff of the Schreiber–Hemlo Program were involved in manning this Mining Sequence Display at the Mines and Mineral Symposium, Intercity Mall during Ontario Mining Week, Geco Family Day—Manitouwadge, Westgate High School, and the Ojibway 1850 Treaty Council.

Publications completed in 1991 included Open File Report 5763 "Field Trip Guidebook for the Nipigon–Marathon Area", by B.R. Schnieders, M.C. Smyk and A.A. Speed; the GAC/MAC/SEG Field Trip A1: "Geology and Gold Deposits of the Hemlo Area". The Schreiber–Terrace Bay mineral occurrence compilation is ongoing.

C. Komar, S. Warren, A. White, J. Russell, D. Chiasson, C. Huska and L. Duff provided clerical assistance and support in Thunder Bay and Marathon.

PROPERTY EXAMINATION—1991

Fire Mountain Property

This property is located approximately 1 km north of Highway 17 on the west side of the Prairie River, 30 km east of Terrace Bay. It was staked by prospectors G. Daniels and J. Courtney in 1991 as part of their OPAP grant-assisted program. The basis of their interest was a newspaper article (*The Daily Journal*, December 5, 1896) which described work being undertaken on what was then called Fire Mountain.

TABLE 7.3. Property Examinations—1991.

1 Big Nama[3]
2 Cabin Carbonate
3 Cold Spring Quarry[1]
4 Coldwell Complex[4]
5 Dead Horse Creek Diatremes[4,5]
6 Dunlop
7 Fairservice[3]
8 Fire Mountain
9 Geordie Lake[4,5]
10 Glacier Creek (Kukkee)
11 Golden Giant Mine
12 Halonen (Cavers)[1]
13 Hays Lake (Joa–Walton)
14 Hemlo Highway Section[4]
15 Heron Bay (Stenlund)
16 Hughes Point[1]
17 Kenel Creek
18 Kusins[3]
19 Lafontaine Fluorite[1]
20 LaGrange Island[1]
21 Lampson Road[3]
22 Little Bear Quarry[3]
23 Marathon Columbium[1]
24 Marathon (Fleck)[4]
25 McKenna–McCann[4]
26 McKirdy Outlier[1]
27 Middleton (Michano)
28 Mozakama Bay
29 Neys Provincial Park[4]
30 Ottise
31 Otter Lake[3]
32 Pick Lake Deposit
33 Port Munroe (Gustafson)[1]
34 Renner Molybdenum[4]
35 Renner Zinc[4]
36 Santoy Lake Pluton[3]
37 Schreiber Channel Nature Reserve[4]
38 Schreiber Highway Vein
39 Selim Siding (Zenmac Tailings)
40 Simard-Swetz
41 Singleton–Gray
42 Slate Islands[4]
43 St. Mary's Bay
44 Sunrise to Sunset Veins[3]
45 Theresa Lake[3]
46 Three Mile Garnet
47 Vert Island[1]
48 W3 Vein
49 Williams Mine[4]
50 Willroy Mine[3]
51 Winston Lake Division Mine[4]
52 Worthington Creek[4]

[1] Visited in conjunction with the Manitouwadge Industrial Minerals Program.
[2] Visited in conjunction with the Manitouwadge Mineral Resource Geologist Program.
[3] Visited in conjunction with the Thunder Bay Amethyst Geologist Program.
[4] Visited during the course of a field trip conducted in 1991.
[5] Visited in conjunction with the Geological Survey of Canada.

The rediscovered description that follows was first noted by Patterson et al. (1986):

> Another property has now come to the front in Algoma in the Fire Mountain [area], known as 362X, which was discovered by Mr. W.H. Arnold about the middle of October and is situated 1.5 miles from northeast of Steel Lake siding, 160 miles east of Port Arthur. This property is something unusual in the mining discoveries of Algoma, as it appears to be nothing short of a gold quarry, one wall only being discovered yet, which is at the base of a mountain, the mountain formerly having no name, but was named by the discoverer. The quarry is one half mile long, following the mountain its entire length, and at present the ore is of a state [sic - slate] formation, highly mineralized and carrying galena, copper and iron pyrites in good quantities. Assays have been made and they run from $1.50 [0.088 ounce] to $40 [2.35 ounces] gold per ton.

Claim 362X was recently located upon receipt of an old claim map and the prospective area was staked. Although the area had been sporadically explored, no mention of old workings nor mineralization resembling the old descriptions was noted. A geological map submitted by The Consolidated Mining and Smelting Company of Canada Ltd. in 1964 (assessment files, Resident Geologist's office, Schreiber–Hemlo District, Thunder Bay) shows an adit which was relocated and visited in 1991.

The adit is situated at the base of a west-facing, 8 m high cliff face. It is 1.2 m wide, 1.8 m high and extends approximately 8 m into the hillside. The adit entrance is partly obscured by talus blocks and material which has sloughed down from the hillside. Blocks of talus and muck are littered along a narrow depression along which a trail leads to the adit. The muck pile is approximately 2 by 3 by 15 m in size. A 15 m long cross-trench was discovered on top of the hill approximately 30 m east of the adit.

Rocks in the vicinity have been highly sheared, resulting in very foliated, fissile phyllites which have either a sedimentary or mafic-volcanic protolith. Whole-rock chemical analyses provided by J. Courtney suggest that the volcanic rocks are dominantly tholeiitic basalt and andesite. At the adit, a 4 m wide gossan has developed in pyritiferous phyllites and more massive, up to 45 cm wide, units rich in quartz. The host rocks are foliated at 100/78S. Banded rocks display tight folds. Mineralization consists of wispy to ribboned, locally massive pyrite and minor chalcopyrite in sericitic and chloritic phyllites and cherty rocks. Small white quartz veins and pods occur locally. Calcite is ubiquitous in altered and deformed rocks; rocks are weakly to strongly carbonatized. Protolith determination is hampered by pervasive alteration and deformation, especially in the vicinity of the adit. Flattened, carbonatized pillowed mafic flows were recognized approximately 100 m north of the adit.

The majority of local rocks on the property are apparently mafic volcanics, consisting largely of pillowed flows and pillow breccias. Interflow sulphide-facies iron formation and graphitic slates comprise a minor portion of the local stratigraphy. Massive and "crack-seal"-textured quartz veins are mineralized with pyrite.

A large, gossanous zone of extensive pyrite mineralization is exposed along and north of the northerly powerline. Samples have returned up to 745 ppb Au (J. Courtney, Prospector, personal communication, 1991). Grab sampling by Ministry staff has returned the assays listed in Table 7.4.

Table 7.4. Assay results for samples from the Fire Mountain Property.

Sample Number	Gold (oz./ton)	Copper (ppm)	Zinc (ppm)
91 BFM - 01	0.012	296	76
- 02	0.002	n.a.	n.a.
- 03	nil	n.a.	n.a.
- 04	trace	n.a.	n.a.
- 05	trace	56	80
- 06	trace	56	324
- 07	trace	60	120

Sample Descriptions:

91 BFM - 01:	45 cm wide zone of massive pyrite + quartz, near adit entrance (grab)
- 02:	rusty-weathering, phyllite rich in sericite, minor disseminated pyrite, minor carbonate, near adit (grab)
- 03:	phyllite rich in sericite with <50% pyrite and sugary quartz bands, minor carbonate, near adit (grab)
- 04:	cherty, dark gray quartz with <50% pyrite in rusty, sheared metavolcanic, trench above adit (grab)
- 05:	sericitic, rusty-weathering phyllite with <50% massive, fine-grained pyrite and quartz lenses, 2 m east of adit (grab)
- 06:	quartz vein and vein breccia with minor pyrite and rare sphalerite, pit on creek (grab)
- 07:	rusty weathering, sheared pillow breccia with lenticular, sericitized fragments, pyrite <10%, northern powerline (grab)

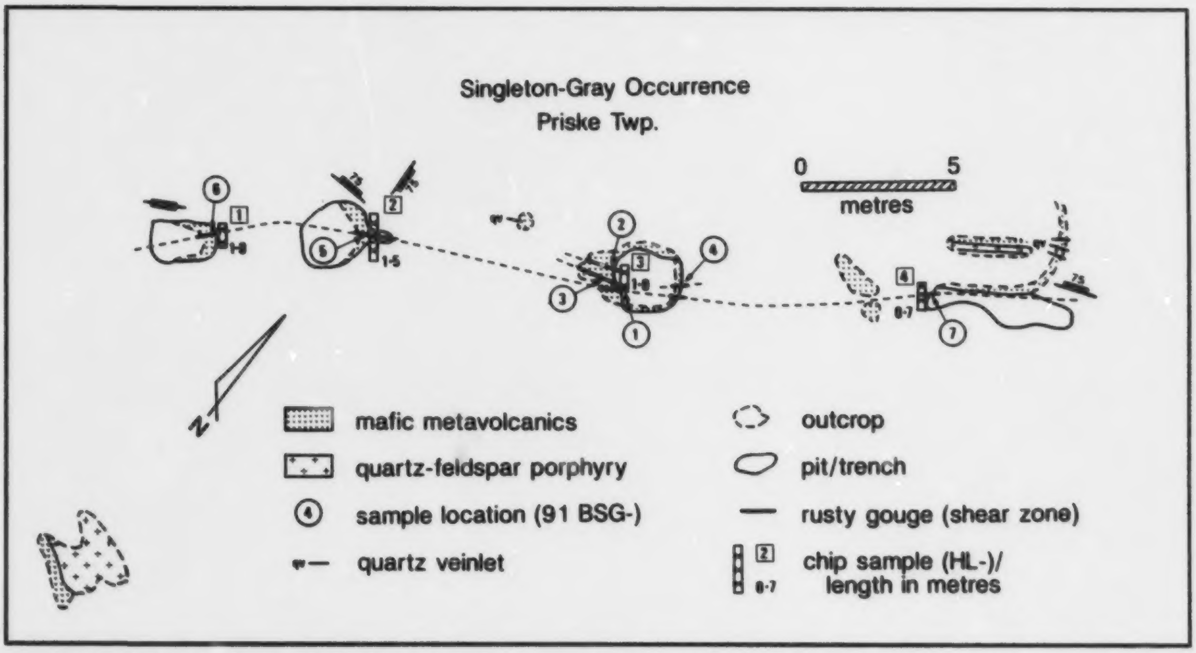
Singleton-Gray Occurrence
Priske Twp.
0
5
metres
N
1
2
3
4
5
6
7
1-8
1-5
1-8
0-7
75
mafic metavolcanics
quartz-feldspar porphyry
sample location (91 BSG-)
quartz veinlet
outcrop
pit/trench
rusty gouge (shear zone)
chip sample (HL-)/
length in metres

Figure 7.4. Geological sketch map of the Singleton–Gray gold occurrence, Priske Township. (*See* "Property Examinations"–1991 for details).

Singleton–Gray Occurrence

The Singleton–Gray gold occurrence, located on the northwestern shore of Hays Lake, 5.2 km east of Schreiber, was first described by Harcourt (1939). The old workings, once thought to have been submerged by the flooding of Bluejay Lake and the creation of Hays Lake were rediscovered and prospected by M. Joa in June of 1991 (Figure 7.4).

Pits and trenches were sunk prior to 1936 on two narrow mineralized zones. The northernmost zone hosts a 1 to 4 cm wide, "bull-white", locally "crack-seal"-textured quartz vein which pinches and swells along a 80° strike. The vein is exposed on the shoreline of Hays Lake and extends under overburden approximately 25 m west to a 2 by 2 by 3 m deep pit. The pit was sunk immediately south of the vein to intersect it at depth as it dipped at 45° to the south. The host

Table 7.5 Assay results for samples from the Singleton occurrence.

Sample Number	Gold (oz./ton)	Silver (oz./ton)
91 BSG - 01	0.120	0.19
- 02	0.018	nil
- 03	0.558	1.00
- 04	0.134	0.38
- 05	trace	nil
- 06	0.016	trace
- 07	0.340	0.20
- 08	0.013	trace
HL - 01	0.002	1 ppm
- 02	0.006	1 ppm
- 03	0.085	5 ppm
- 04	0.376	6 ppm
- 05	<0.002	<1 ppm
- 06	0.004	2 ppm
- 07	0.049	20 ppm
- 08	0.002	1 ppm
- 09	1.323	68 ppm

(n.b. HL-01 to -09, M. Joa, Prospector, personal communication, 1991)

Sample Descriptions:

Southern Zone

91 BSG - 01: gouge rich in sulphide in altered mafic metavolcanics, pit No.3, west end, chip sample across 1 m
- 02: gouge rich in sulphide, "upper" shear zone, pit No.3, west end (grab)
- 03: quartz vein in rusty gouge, pit No.3, west end (grab)
- 04: sugary quartz in rusty gouge, pit No.3, east end, chip sample across 1 m
- 05: rusty gouge, pit No.2, east end (grab)
- 06: quartz vein with pyrite in mafic metavolcanics, pit No.1, east end, chip across 1 m
- 07: quartz vein with euhedral pyrite, pit No.4, west end (grab)
- 08: quartz vein, shoreline of Hays Lake (grab)

HL - 01: 1 m chip across face of pit No.1; fine-grained mafic volcanics, rusty shear zone on each side of sample containing quartz vein material; 1 to 2% pyrite.
- 02: 1.5 m chip across face of pit No.2; two shear zones including 1.5 cm quartz-carbonate vein. <1% pyrite.
- 03: 1 m chip across pit No.3 face; includes three quartz carbonate veins, very oxidized mafic volcanics.
- 04: 0.7 m chip across pit No.4 face; sheared mafic volcanics with 2 to 4% pyrite.
- 05: quartz-feldspar porphyry, 5 m south of pit areas, no visible sulphides (grab).

Northern Zone

- 06: 0.5 m chip of quartz-feldspar porphyry, <1% pyrite.
- 07: quartz-carbonate vein with sericitic, "crack-seal" texture, 1% pyrite, north of pit (grab).
- 08: very fine-grained, silicified, aplitic porphyry, 1% pyrite, south of pit (grab).
- 09 quartz-carbonate vein material of north vein extension on lakeshore; 1% pyrite and <1% chalcopyrite (grab).

rock exposed in the pit is a grey to pink quartz-feldspar porphyry. The vein is not exposed in the pit, perhaps due to the partial collapse of the pit walls. Pyrite occurs sparingly in the exposed portion of the vein and occurs as disseminated grains in the host porphyry. Harcourt (1939) noted that the fracture zone extended into mafic metavolcanic rocks where it consisted of a 5 to 7.5 cm wide alteration zone consisting of fine quartz, sericite, sulphides and some gold that assayed 0.06 ounce Au per ton.

The southern zone occurs 45 m south of the northern pit and consists of a narrow structure striking between 50° and 75° which has been exposed in four pits and overburden stripping over a strike length of 45 m. The mineralized zone consists of an 8 to 20 cm wide, rusty, pyritiferous, gouge-filled shear zone in massive, coarse-grained, amphibolitic mafic metavolcanic rocks. Several smaller splaying shear zones up to 10 cm wide extend off of the main structure but are not as well exposed. In one pit, the mineralized zone (three narrow shears) has a maximum width of 1 m. In some places the rusty shear zone hosts a 2 to 4 cm wide quartz vein which is mineralized with pyrite. Native gold was noted in the quartz vein by Harcourt (1939). A small body of quartz-feldspar porphyry occurs a few metres south of the main pits and one narrow quartz-feldspar porphyry dike was observed at the eastern exposure. The quartz-feldspar porphyry contained quartz eyes up to 10 mm in size and in one location phenocrysts were flattened, likely due to a narrow shear zone. On the lakeshore, a narrow quartz vein up to 10 cm wide strikes 85° and dips 45° to 60° S.

Grab and chip sampling of the two occurrences returned the assays listed in Table 7.5.

A quartz vein similar to those described above was noted by Harcourt (1939) to the north of the main Singleton–Gray occurrence and returned 0.63 ounce Au per ton. Recent prospecting by M. Joa has led to the discovery of a vein approximately 500 m to the northeast, on the north side of Hays Lake, which is suspected to be this more northerly vein. A rich in chalcopyrite, malachite-stained grab sample returned 0.015 ounce Au per ton, trace Ag and 0.227% Cu.

The rocks and geological setting of the Singleton–Gray occurrence are very similar to that of the Joa–Walton (Schnieders and Smyk 1989) and Hays Lake (Derraugh–Jedder) gold occurrences. Gold occurs in altered mafic metavolcanic rocks and interflow metasedimentary units proximal to the Terrace Bay batholith, but is most notably concentrated in quartz-feldspar porphyry and quartz-carbonate veins, where it occurs with base-metal sulphides. Alteration zones and quartz+/-carbonate veins commonly occur at the contact between quartz-feldspar porphyry and the metavolcanic rocks and represent excellent exploration targets. However, the porphyry bodies themselves should also be considered as exploration targets. Alteration of the metavolcanic rocks and the porphyries can include silicification, carbonatization and potassic alteration commonly dis-

Table 7.6. Chemical analysis from the Three-Mile Garnet occurrence.

Sample Number	Gold (oz./ton)	Silver (oz./ton)	Copper (ppm)	Zinc (ppm)	CaO (ppm)	MgO (ppm)	Na_2O (ppm)
91 BTM-01	trace	trace	147	117	12103[1]	10778[1]	2130[1]
					55300[2]	34800[2]	20900[2]

[1] acid digestion sample preparation)
[2] lithium metaborate fusion sample preparation)

played by the development of sericite schist. Recent chip sampling of the Joa–Walton occurrence on the east side of Hays Lake returned 51.1 g/t Au over 3 m across a contact between quartz-feldspar porphyry and mafic metavolcanic rocks with two small quartz veins (M. Joa, Prospector, personal communication, 1991). In addition samples of altered, carbonatized metavolcanic rocks sampled by the authors assayed up to 0.09 ounce Au per ton and samples of quartz porphyry not associated with quartz veining and relatively unaltered assayed up to 6360 ppb (0.20 ounce) Au per ton (M. Joa, Prospector, personal communication, 1991).

Three-Mile Garnet Occurrence

This occurrence is located approximately 4.4 km west of Schreiber on the Canadian Pacific Railway, at a point approximately 400 m east of the Mileage 3 sign on the railway. The occurrence was first noted by Hopkins (1922) as "garnet gneiss" on the accompanying map. Although subsequent mapping had not noted this garnetiferous unit, the presence of intermediate to felsic pyroclastic rocks in the area (Harcourt 1939, Carter 1988) prompted its recent investigation.

Local rocks consist mainly of heterolithic lapilli tuff and tuff-breccia in which mafic, feldspar-phyric clasts predominate over light grey, feldspar- and amphibole-phyric clasts. The clasts are fine-grained to aphanitic and occur in an aphanitic, light grey, feldspar- and amphibole-phyric matrix. Quartz phenocrysts are notably absent and plagioclase phenocrysts are locally saussuritized. The rocks are not strongly foliated, but the subangular clasts are slightly flattened at 280/56N. Clasts vary in length up to 10 cm, but average 3 to 7 cm.

In the vicinity of the garnetiferous rocks, these plagioclase- and amphibole-phyric tuffs are white- to light grey-weathering. Plagioclase may locally form foliation-parallel bands 2 mm wide. Garnets up to 1 cm in diameter are exposed as protruding knobs on the south side of the railway rock cut. They may comprise up to 50% of the host rock locally. The host rock varies from a rusty weathering, dark grey feldspar-biotite schist to a massive, dark green amphibolite. Garnets occur as lenticular masses and euhedral crystals occurring with magnetite and quartz in bands 0.5 to 3.5 cm wide. These bands define a foliation at 284/52N and occur within a light green-grey groundmass in which 1 to 2 mm amphibole phenocrysts are developed. The garnetiferous portion of the metavolcanic rocks has an exposed thickness of approximately 3 m and outcrops on the north side of the tracks. Minor pyrite occurs on joints and with garnets as fine-grained blebs and aggregates.

In thin section, the rock consists dominantly of euhedral, poikiloblastic garnet, rimmed by finer grained, decussate biotite and amphibole, which also tend to concentrate in the strain shadows of the porphyroblasts of garnet. Some biotite has been altered to secondary amphiboles. Quartz and lesser plagioclase comprise the felsic mineral assemblage, largely interstitial to the mafic constituents. Opaque minerals, dominantly magnetite, are fine grained and disseminated or occur as somewhat foliation-parallel trains in the garnet porphyroblasts. No other minerals characteristic of hydrothermal alteration associated with volcanogenic massive sulphide deposits were noted.

Chemical anaylsis of a grab sample from the zone rich in garnet returned the assay listed in Table 7.6.

Middleton (Michano) Copper Occurrence

Copper mineralization was discovered by prospectors in 1989 along the Canadian Pacific Railway 150 m northwest of the Middleton section signpost on the railway, approximately 25 km west-northwest of Marathon. The occurrence was visited in 1991 with prospector P. Moses.

Local rocks are part of the northeast-trending sequence of intercalated metavolcanic and metasedimentary rocks that comprise a portion of the Terrace Bay greenstone belt and lie within the contact metamorphic aureole of the Coldwell alkalic complex (Walker 1967). Local mafic metavolcanic rocks are foliated at 260/74N and consist mainly of dark green to black, massive flows. Highly flattened, vesicular pillows are locally evident. There are some coarser grained, gabbroic-textured rocks that are not as strongly foliated. The host rocks are weakly to moderately carbonatized, with some vuggy, sparry calcite. Pyrite occurs sparingly as widely disseminated grains. Narrow, foliation-parallel diabase dikes intrude the Archean rocks.

The copper occurrence is characterized by the extensive development of malachite as a precipitate coating fracture, joint and foliation surfaces. More remarkable is the fact that cobble-sized lumps of sandy to gravelly soil at the base of the rock cut have been cemented by malachite and calcite. Individual lumps may consist of up to 40% carbonate. The malachite-stained zone extends along the west side of the tracks for approximately 50 m, with malachite coatings developed every metre or so. Grab sampling returned the following assays:

Sample Number	Gold (oz./ton)	Silver (oz./ton)	Copper (%)	Zinc (%)
89 BGM-04	0.002	trace	0.384	0.008
-05	0.005	0.10	6.590	0.016
-06	0.064	4.34	13.925	0.019
91 BMM-01	nil	nil	0.055	0.008
-03	nil	nil	4.860	0.014

Sample Descriptions

89 BGM-04:	malachite-stained, foliated mafic volcanic
-05:	well-consolidated, malachite + calcite-cemented sand and pebbles
-06:	massive pyrite pebbles in cement rich in limonite + malachite
91 BMM-01:	malachite-stained, gossanous, foliated mafic volcanic
-03:	rusty, malachite-cemented sand with polymictic pebbles

Ubiquitous quartz-carbonate veinlets up to 1 cm wide are usually foliation-parallel, while larger veins up to 10 cm wide may be oblique to foliation. The veins are variably mineralized with up to 5% pyrite and tourmaline and returned trace amounts of gold.

The extensive development of malachite can be related to surface alteration of the mafic metavolcanic host rocks by meteoric waters rich in oxygen. The oxidation of pyrite in the host rocks causes the formation of sulphuric acid and ferrous sulphate, which results in the breakdown and dissolution of copper-bearing sulphides like chalcopyrite. The carbonatized host rocks contain abundant calcite which will dissolve to provide carbon dioxide which will react with the copper-bearing solutions to form and precipitate hydrated copper carbonates like malachite and azurite, in addition to calcite. The formation of iron oxides and hydroxides like limonite will often accompany this process. Supergene processes usually result in the enrichment of metal grades because metals are redeposited and concentrated, while the host rocks may be leached and depleted in those metals. The immediate source of the copper at this occurrence has not as yet been ascertained, but it is reasonable to assume that primary copper sulphides exist in significant quantities in the mafic metavolcanic rocks at this locality and perhaps elsewhere nearby. The discovery of this copper occurrence reiterates the importance of recognizing secondary minerals, "blooms" and gossans during prospecting.

Renner Zinc and Molybdenum Occurrences

These two occurrences were discovered by prospectors R. Renner, P. Rowe and J. Comeau and further investigated and visited in 1991 as part of an OPAP grant-assisted program. They are located approximately 18 km north-northeast of Marathon, 5 km southwest of Louis Lake.

The zinc occurrence is exposed in a series of long overburden and rock trenches that are located on the top of a large, north-trending ridge that forms the east side of the Pic River valley. An original grab sample that was collected during reconnaissance prospecting in 1990 returned 0.5% Zn (R. Renner, Prospector, personal communication, 1991). The area was subsequently stripped and sampled.

The host rocks are fairly massive, dark green, mottled mafic metavolcanics which are deeply fractured and rusty weathered. No discernable foliation has developed, possibly due to recrystallization accompanying amphibolite-facies contact metamorphism with enveloping granitoids. Pyrite aggregates may comprise up to 5% of the rock. Narrow, anastomosing shear zones are richer in pyrite and are characterized by highly crenulated, chloritic folia. A narrow (0.6 m) unit of thinly banded white chert + calcite with some pyrite strikes at approximately 040° but is highly brecciated and dismembered.

Two other areas were stripped and investigated nearby. The "Magnetic Pull" showing lies approximately 150 m north and consists of moderately magnetic, feldspar-phyric, massive mafic metavolcanics. Some narrow, pink, felsic dikes and narrow, white, quartz veins are folded and/or dismembered. The "Porphyry" showing lies 150 m east of the zinc occurrence. It is underlain by apophyses of pink aplite and quartz porphyry which have intruded coarse-grained, amphibolitized mafic metavolcanics. Some felsic dikes, 10 to 20 cm wide, are mineralized with quartz, purple fluorite and rare chalcopyrite (+ malachite). The quartz porphyry consists of up to 6 mm anhedral to subhedral quartz phenocrysts in a pink, fine-grained matrix. The porphyry has been traced for 200 m to the east where it disappears under thick overburden.

The molybdenum occurrence lies approximately 500 m east of the zinc occurrence and is exposed on a north-facing slope near a swampy depression. It was first discovered in 1988 under an overturned tree. The mineralization occurs in a "bull-white" quartz vein, hosted in white- to pink-weathered, locally quartz-phyric granite. Contact relationships are obscured by the rubbly nature of the exposure, but it is believed that the vein probably strikes roughly east. The granite varies in texture from fine-grained aplitic to medium-grained equigranular. Blocks of massive to "crack-seal"-textured quartz up to 1 m wide are common. Reticulate quartz veinlets up to 1 cm wide extend marginally to the main vein, into the host. Granitic xenoliths

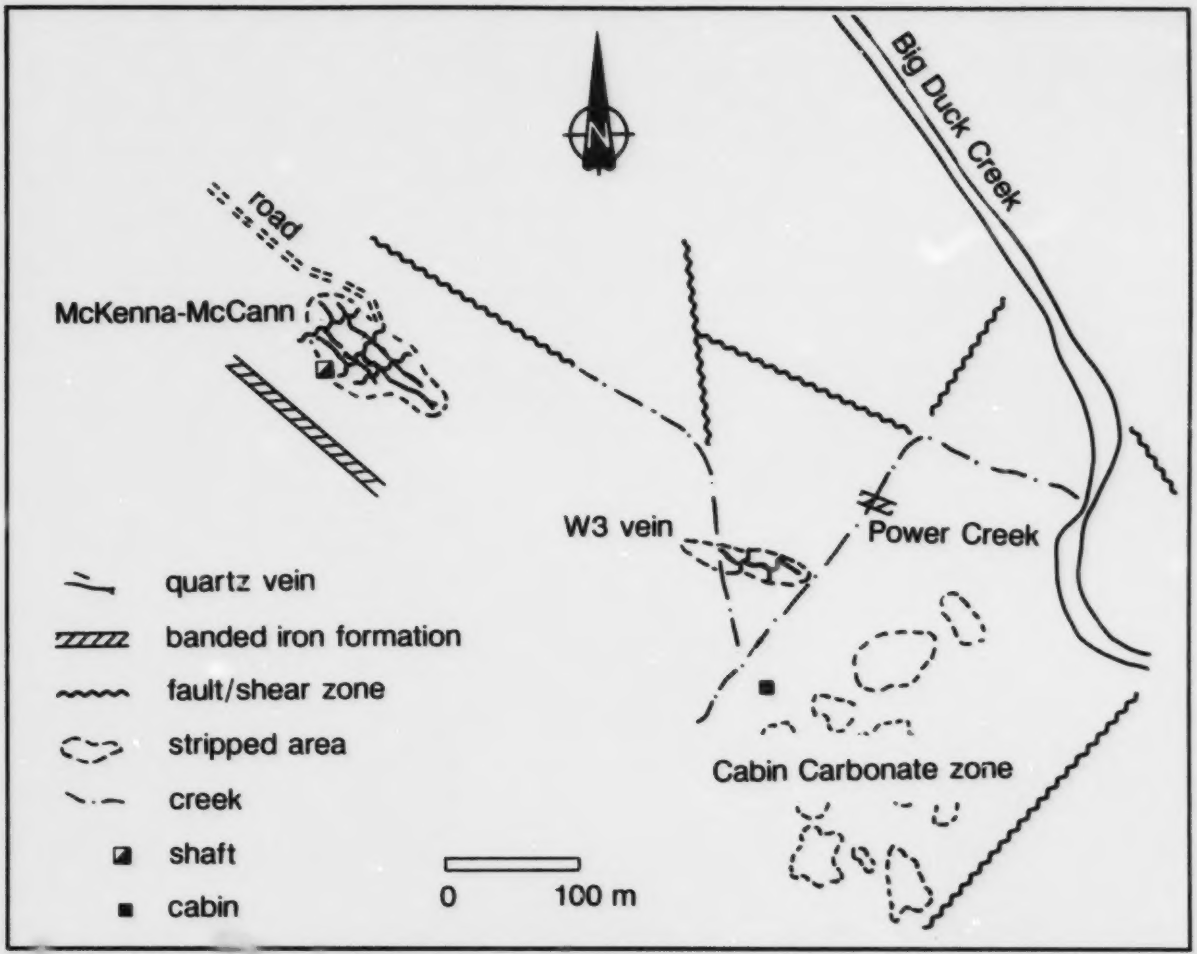

Figure 7.5. Geological sketch map of mineralized zones near the McKenna–McCann gold prospect, Priske Township (*see* "Property Examinations"–1991 for details).

are found in the veins. A sheared contact with fine-grained, dark green, pyritiferous metavolcanics to the south extends at 228/58NW. Narrow, feldspathic veinlets and larger felsic dikes crosscut the metavolcanics.

Fine-grained aggregates of molybdenite may comprise up to 25% of the quartz-vein host. These aggregates and narrow stringers are generally confined to fractures and "crack-seal" planes. Molybdenite has been extensively altered to yellow ferrimolybdite stain. Pyrite occurs as small, rare euhedral crystals in the vuggy portions of the vein and as finer-grained, disseminated grains in the granite host.

Grab samples collected in 1988 returned up to 1.04% Mo and 0.02 ounce Au per ton (Resident Geologist's files, Schreiber–Hemlo District, Thunder Bay). Typical assays of molybdenite-bearing quartz range from 0.1 to 0.3% Mo, and up to 13 g/t Ag.

A bluff exposure of medium-grained, quartz-phyric granite, 150 m west, returned 290 ppb Au (R. Renner, Prospector, personal communication, 1991).

Prospecting on an island in the Pic River approximately 8 km north of these two occurrences in 1991 led to the discovery of a variety of mineralized float samples. Samples rich in chalcopyrite returned assays up to 8890 ppm Cu and 198 ppb Au. Samples of gneissic rocks rich in quartz contained flake graphite. The bedrock source of the float material is still being sought by the prospectors.

McKenna–McCann Property

Prospectors W. Acker and R. Otto hold this property, located approximately 3.2 km northeast of Schreiber. A number of gold occurrences and target areas have been investigated over the last several years, adjacent to the McKenna-McCann prospect, whose exploration history dates back to the 1930s. These include the Power Creek occurrence (Schnieders and Smyk 1990), the Cabin Carbonate zone and W3 vein (Schnieders et al. 1991) (*see* Figure 7.5).

As part of an OPAP grant-assisted program, further exploration work was undertaken in 1991, chiefly on the W3 vein and on the McKenna-McCann property itself. Overburden stripping was carried out with heavy equipment and a Wajax water pump. The newly stripped areas uncovered the W3 vein over a strike length of approximately 100 m. The vein tends to pinch and swell and attains a maximum width of 1.8 m. It is offset in several places by northeast-striking shear zones and faults, resulting in sinistral displacements up to approximately 8 m, and a section of the vein has therefore been referred to as the W3 Extension. The strike extensions of the W3 vein have not as yet been traced to the east or west past two ravines that probably represent faults as well.

W3 (Extension) vein samples collected by Ministry staff in 1991 returned the assays listed in Table 7.7.

The McKenna–McCann prospect was first described by Harcourt (1939). Cook Lake Gold Mines Limited was organized to develop the property following similar discoveries on the adjoining Johnston–McKenna property to the northwest. The main stripped area has exposed four sets of parallel, *en échelon* quartz veins which strike northwest. The veins have been numbered 8, 9, 10 and 11; veins numbered 1 through 7 are believed located on the Johnston–McKenna property, although only veins numbered 1 through 4 are actually documented in the literature within the mineral deposit and assessment files. The host rock is carbonatized, pillowed andesite, which has been intruded by diorite to the north. An iron formation has been mapped to the south and strikes northwest as well. The veins tend to pinch and swell and have been offset and truncated by northeast-trending shear zones/faults. They are variably mineralized with pyrite, chalcopyrite, galena and fine, native gold. Surface sampling of a 30 m section of vein No. 9 by Cook Lake Mines returned 0.256 ounce Au per ton over 0.36 m, while the same section returned a twelve-ton bulk sample assay of 0.82 ounce Au per ton (Harcourt 1939).

A 3 by 3 m shaft was sunk ca. 1939 to a depth of 35 m, south of the south-dipping veins. The shaft and 150 m of underground workings were dewatered and sketch-mapped

Table 7.7. Assay results from the W3 (Extension) vein.

Sample Number (oz./ton)	Gold (oz./ton)	Silver (ppm)	Copper
91 BW3 - 01	0.003	trace	n.a.
- 02	0.011	nil	n.a.
- 03	0.007	trace	n.a.
- 04	0.009	trace	150
- 05	0.027	trace	1109
- 05A	0.013	trace	802
- 06	0.135	0.19	590
- 07	0.255	1.73	2145
- 08	0.037	trace	253
- 09	0.026	trace	414
- 10	0.029	trace	n.a.
- 11	0.006	nil	n.a.
- 12	0.003	nil	n.a.
- 13	trace	trace	n.a.

Sample Descriptions:

91 BW3 - 01:	"crack-seal"-textured, rare sulphides, northwest end (grab)
- 02:	10 to 15 cm wide, "crack-seal"-textured, minor pyrite (grab)
- 03:	10 cm wide chip across whole vein, "crack-seal"-textured, minor pyrite
- 04:	90 cm wide chip across whole vein, <5% chalcopyrite + malachite
- 05:	massive quartz poor in sulphide (grab)
- 05A:	"crack-seal"-textured, <3% chalcopyrite (grab)
- 06:	"crack-seal"-textured, minor sulphides (grab)
- 07:	rich in epidote, "crack-seal"-textured, minor chalcopyrite (grab)
- 08:	rich in pyrite quartz, eastern end (grab)
- 09:	60 cm wide chip across vein poor in sulphide
- 10:	"crack-seal"-textured eastern end poor in sulphide (grab)
- 11:	1.8 m chip across vein, southeastern end
- 12:	vein float, Power Creek area, minor pyrite (grab)
- 13:	green mica- and rich in carbonate altered mafic volcanic, with minor quartz and pyrite, 120 m southeast of W3

by the prospectors in 1991. A 47.5 m long crosscut extends north-northeast from the shaft bottom. Approximately 9 m from the shaft, it intersects a 90 m long drift which extends west-northwest. The drift follows a 15 to 75 cm wide vein (No. 9) along its length and bifurcates for several metres at each end where the vein is apparently offset by a crosscutting structure. Vein exposures in the main drift were sampled and the results are presented in Table 7.8

It has been suggested that the newly exposed W3 vein could be the southeasterly strike extension of the No. 10 vein. Although this is difficult to prove because of numerous intervening, crosscutting structures, this would extend the length of the McKenna–McCann vein system to over 500 m. Moreover, the McKenna–McCann veins are perhaps part of the same vein system as that exposed on the Johnston–McKenna property, 1.6 km to the north-northwest. This model will be tested with stripping planned in 1992 between the two properties.

RECOMMENDATIONS FOR EXPLORATION

Gold

The authors advise that the recommendations made in previous annual reports of the Resident Geologists are excellent sources of information and contain many stimulating ideas, models, trends and tidbits of information. The "Recommendations for Exploration" as well the "Property Examinations" sections of these reports contain information that never becomes outdated and while models may change, good property descriptions, observations and assay values will always be invaluable. In addition, the information within the data bases available at the Resident Geologists' offices, namely the assessment files, mineral deposit files and historical research files, are of great use to the prospector and explorationist.

A number of gold anomalies exists on the regional lake sediment geochemistry maps (Open File 2360, 2362) of Friske et al. (1991a, 1991b). While some anomalies, like those centered around Heron Bay and Big Duck Lake, can be accounted for by known gold mineralization, the majority of the identified anomalies cannot. These include anomalies located near Swede Lake, north of Cirrus Lake and near Fourbay Lake (42D16/NE); near Dead Horse Creek in Walsh Township (42D15/SE); near and southwest of Goodchild Lake (42D16/SE); and near Kabamichigama Lake (42E04/NE). A strong gold anomaly with coincident silver and uranium anomalies occurs south of Long Lake near Eightmile Narrows and Catlonite Lake (42E03/NE). In addition, many smaller, less pronounced gold-anomalous areas exist. A detailed map is available in Friske et al. (1991a, 1991b) to pinpoint exact sample locations.

It is interesting to note that many known gold occurrences are not manifested on the geochemistry map. Hemlo, for example, has no anomalous expression on the regional scale map. Although a more detailed sampling program did produce anomalous results in gold, molybdenum and antimony near the deposit (Friske 1991), some of the gold values proved to be non-reproducible. This is the result of a particle sparsity effect in which very-low concentrations of gold are heterogeneously enriched in the surficial environment (Friske 1991). This sampling problem is unique to gold because of its occurrence in native form, its chemical and

Table 7.8. Assay results for samples from vein exposures in the main drift, McKenna–McCann Property.

Sample Number	Gold (oz./ton)	Silver (oz./ton)
91 BWA - 13	1.087	0.18
- 14	0.671	0.20
- 15	0.004	trace
- 16	0.017	nil
- 17	0.003	trace

Sample Descriptions:

91 BWA - 13:	massive to "crack-seal"-textured; calcite and blebby pyrite concentrated along chloritic slickensides and along fractures; grab sample, 1.5 m east of shaft
- 14:	massive, "bull-white" to "crack-seal"-textured, with green sericite and calcite, fine-grained, disseminated pyrite; grab sample, 12 m east of shaft
- 15:	similar to - 14, with green sericite, calcite and chloritic seams; grab sample, 10.7 m east of shaft
- 16:	similar to - 14, - 15, with abundant green sericite, chlorite, calcite and minor sulphides; chip sample over 61 m from shaft to west end of drift
- 17:	more massive, sugary-textured quartz with carbonatized mafic volcanic host rock, much fine-grained, disseminated pyrite euhedral; grab sample, 61 m west of shaft

physical resistance, high specific gravity and low concentration levels (Harris 1982). It is therefore important to consider looking for anomalies displayed by commonly associated pathfinder elements, such as antimony, tungsten, arsenic, mercury and molybdenum, reanalyzing anomalous samples, resampling and conducting ground follow-up.

Colvine et al. (1988) suggest that in many Archean gold situations, mineralized zones are often elongate and plunging. Mineralized zones commonly plunge parallel to the stretch lineation or to an intersection lineation. Gold mineralization on properties such as the Stenlund property in Heron Bay appear to have a close association with structural controls and quartz-feldspar-porphyritic rocks. In addition, the rocks have undergone up to four periods of deformation including tight to isoclinal folding with westerly plunging fold axes and mineral lineations, producing a highly complex association between the mineralized zones, structural controls and associated host rocks. In such cases, careful documentation of the geology, alteration, mineralization and structural features achieved by initial mapping and stripping programs may prove to be useful tools when trying to understand the complex relationships and discover additional mineralized zones. This two-dimensional-based exploration along with sound geological interpretation and modeling is the best way to minimize exploration risk and maximize potential for success before costly three-dimensional drilling programs are initiated. Whether one is exploring a narrow pinch-and-swell, *en échelon* quartz vein system in the Schreiber area or the "sheet-like" Hemlo ore zone, these parameters must be considered.

Recent exploration and discoveries during the past several years in the Schreiber area have once again confirmed the presence of high-grade, gold-bearing, quartz-vein systems, commonly but not always at or near the contact between quartz-porphyritic rocks and metavolcanic rocks. More and more gold occurrences are being discovered associated with altered metavolcanic rocks (Joa–Walton, Cabin Carbonate, Singleton-Gray properties) unaltered and altered quartz porphyry (Joa–Walton, Hays Lake, Worthington Creek, and North Shores Mine properties), and altered and deformed iron formation (Power Creek, Otisse properties). Very few thorough exploration programs have been carried out on these Schreiber properties, and to stress this point, one has to only look at the gold system which includes the Harkness–Hays, Gold Range, Otisse, Singleton–Gray, Joa–Walton and Hays Lake properties and the greater than 5 km long strike length they represent or the Johnston–McKenna, McKenna–McCann and W3 properties, representing a vein system with a potential strike length of greater that 2 km, which to this date has yet to be diamond drilled.

In addition, properties such as the North Shores Mine and Worthington Bay area also represent excellent gold-exploration targets. These gold-vein systems combined with the increasing number of gold occurrences associated with host rocks make the Schreiber area an excellent target area for gold mineralization. The present day analogy for Schreiber gold mineralization is "there is lots of smoke but no fire". However, recently the smoke has gotten a lot denser. Where is that fire?!

Another area considered to be an excellent gold exploration target is the Big Duck Lake area and its better than 20 known gold occurrences. Once again, gold mineralization is associated with quartz+/-carbonate veins, quartz-porphyritic rocks and altered metavolcanic rocks.

Another gold exploration target may be claim TB 828668 which at the time of writing was held by Noranda Exploration Company Limited and joint-ventured to Minnova Inc. Bartley (1939) described the property: " A short distance southeast of the long bay in Rhea lake, test pits were sunk on a mineralized porphyry dike. Low gold values were obtained, but the deposit was non-commercial." How "low", these low gold values were, is currently unknown. One cannot over-emphasize the importance of quartz-feldspar-porphyritic rocks and structural controls to gold mineralization in the Schreiber–Hemlo area.

Base Metals

SCHREIBER AREA

The Schreiber area has historically been regarded as a "gold-only" camp. Recent base-metal exploration activity in the Winston and Victoria lakes area should serve to raise awareness of the possibility of base-metal deposits in the metavolcanic belt nearer to Schreiber.

The geology near Schreiber has been documented by Hopkins (1922), Harcourt (1939) and Carter (1988). Although mafic metavolcanic rocks comprise the bulk of the volcanic succession, there is a large proportion of intermediate to felsic rocks consisting of pyroclastic and flow units. Lapilli tuffs and tuff-breccia (agglomerate) have been identified in many areas. Rhyolite, which comprises a lesser but important part of the succession, occurs immediately south of Schreiber. It is believed that some of the quartz porphyry that had been previously mapped is in fact quartz-phyric rhyolite where it occurs within the volcanic succession. Plagioclase-phyric rocks predominate to the west of Schreiber and are more intermediate in character.

The Schreiber–Hemlo greenstone belt should be thoroughly prospected. Exploration programs involving database research, reconnaissance mapping, lithogeochemistry and geophysical surveys should also be considered. Database research and prospecting will assist in discovering new and old base-metal occurrences, rusty and gossanous zones, as well as alteration zones. Mineral assemblages reflective of base-metal alteration may include anthophyllite, biotite, sillimanite, garnet, cordierite, andalusite and kyanite in higher-grade metamorphic terranes, and chlorite, sericite, chloritoid

and carbonate in lower-grade metamorphic terranes. Lithogeochemical surveys, to detect sodium and calcium depletion, and magnesium, potassium, zinc and copper enrichment, are considered valuable exploration tools for identifying hydrothermal alteration zones associated with massive-sulphide base-metal deposits. Commonly the alteration zones are larger targets than the sulphide deposits and can be used to find the "needle in the haystack". Geophysical surveys will help to delineate anomalies or conductors within the alteration package. Areas to consider include the Lyne Lake–Victoria Lake–Ansell Lake area, Ducell Lake–Rhumly Lake–Santoy Lake area, Santoy Lake–Marlhill area and the Cairngorm Lake area, just to name a few.

Sulphide- and oxide-facies iron formation is intercalated with the metavolcanic rocks in a number of areas. A persistent iron formation, occurring west and south of Schreiber, hosts several massive pyrite-pyrrhotite occurrences, including the Morley and Elwood showings. This unit and the associated metavolcanic rocks are offset by several sub-parallel faults that extend north-northeast. Other notable iron formations rich in sulphide to the north and east include the Mudge and those on the Schreiber-Pyramid property. In many places, significant base-metal and gold values have been returned from these iron formations. Disseminated sulphides and small massive sulphide bodies have been noted in rhyolitic rocks by Harcourt (1939).

Mineral assemblages ascribed to hydrothermal alteration accompanying volcanogenic massive sulphide deposition have not been noted as such. Such alteration would most easily be recognized locally by the development of chlorite, sericite and/or garnet or other minerals, depending largely on the intensity of alteration and the nature of the host rocks. Garnetiferous rocks have been noted west of Schreiber (*see* "Property Examinations") in an area that has attracted very little prospecting activity, despite having favourable geology for both base metals and gold.

ST. IGNACE ISLAND AREA

St. Ignace Island consists mainly of Mesoproterozoic (Keweenawan) flood basalts which are overlain by a composite volcano-sedimentary sequence with a mafic to felsic intrusive core in the southeastern part of the island (Sutcliffe and Smith 1988). It has been explored sporadically in the past for copper and silver. Local exploration activity has been summarized by Giguere (1975) and Sutcliffe and Smith (1988). Exploration has focused on the Nipigon Strait (Dampier), Moffat Strait and St. Ignace Harbour (Otter Bay) occurrences. The following composite descriptions are taken from the aforementioned references and the Resident Geologist's files and assessment files, Schreiber–Hemlo District, Thunder Bay.

The Moffat Strait and St. Ignace Harbour occurrences consist of steeply dipping mineralized zones in flat-lying, amygdaloidal basalts. Narrow (3 to 20 m) deformation zones host 0.7 to 1.8 m wide calcite-quartz veins mineralized with disseminated chalcocite with lesser chalcopyrite, bornite and native silver. Veins commonly return 0.1 to 0.3% Cu over narrow widths. Two veins at Moffat Strait returned 1.76% Cu and 4.5 ounces Ag per ton over 1.3 m, and 2.32% Cu and 15.2 ounces Ag per ton over 0.75 m, respectively. Copper sulphides also occur in amygdules with calcite, zeolites and quartz.

The Nipigon Strait (Dampier) occurrences consist of native copper (+ malachite) in amygdules or disseminated in the host basalts in association with calcite, prehnite and chlorite. A 0.18 m core sample returned 0.59% Cu and 0.08 ounce Ag per ton; silver assays commonly ranged up to 0.6 ounce per ton.

In addition to these properties, other copper and/or sulphide occurrences have been noted and are recommended for investigation. Giguere (1975) discovered cobbles and pebbles of native copper in prehnite in glacial drift on the eastern shore of McEachan Lake but did not locate their source. Minor copper mineralization has been noted by Sutcliffe and Smith (1988) in feldspar-phyric rocks of the St. Ignace Island intrusion east of King Lake. Disseminated chalcopyrite was noted in fractured and argillic (quartz-kaolin-chlorite)-altered rocks and may represent "porphyry copper"-type mineralization. The gabbro-anorthosite ring dike surrounding the central porphyry core hosts disseminated sulphide occurrences and should be investigated for copper-nickel-platinum group element occurrences.

Renewed exploration interest has followed recent discoveries of copper mineralization in Paleoproterozoic to Mesoproterozoic volcanic and sedimentary rocks in the Thunder Bay area. In light of this activity and new petrogenetic models for Keweenawan volcanism and metallogenesis, perhaps a reconsideration of the geology and mineral potential of the offshore islands is warranted.

Numerous base-metal anomalies are depicted on the lake sediment geochemistry maps prepared by Friske et al. (1991a, 1991b). In contrast to the gold anomalies these anomalies tend to be more broadly distributed and represent elevated background metal values in grossly similar packages of rocks. For example, the greenstone belts in the Jackfish–Middleton and Goodchild Lake areas show uniformly higher responses in copper, nickel, zinc and lead than do the enclosing granitoid rocks. These rocks have a demonstrated potential for base-metal deposits. The Big Duck Lake area, which is anomalous in copper, zinc, silver, molybdenum and gold, hosts the producing Winston Lake zinc-copper-silver mine, as well as a multitude of gold occurrences and prospects. Interesting areas which cannot be readily accounted for by known geology include coincident chromium-cobalt-iron-molybdenum anomalies south of the Gravel River fault in the Nagunagisic Lake area, north of Cavers (42D/13 north, 42E/04 south). Distinct lead-fluorine-uranium anomalies exist north of Pays Plat and may be related to galena-(+ silver-)bearing quartz-calcite-fluorite-barite veins and/or a small outlier of Paleoproterozoic sedimentary rocks.

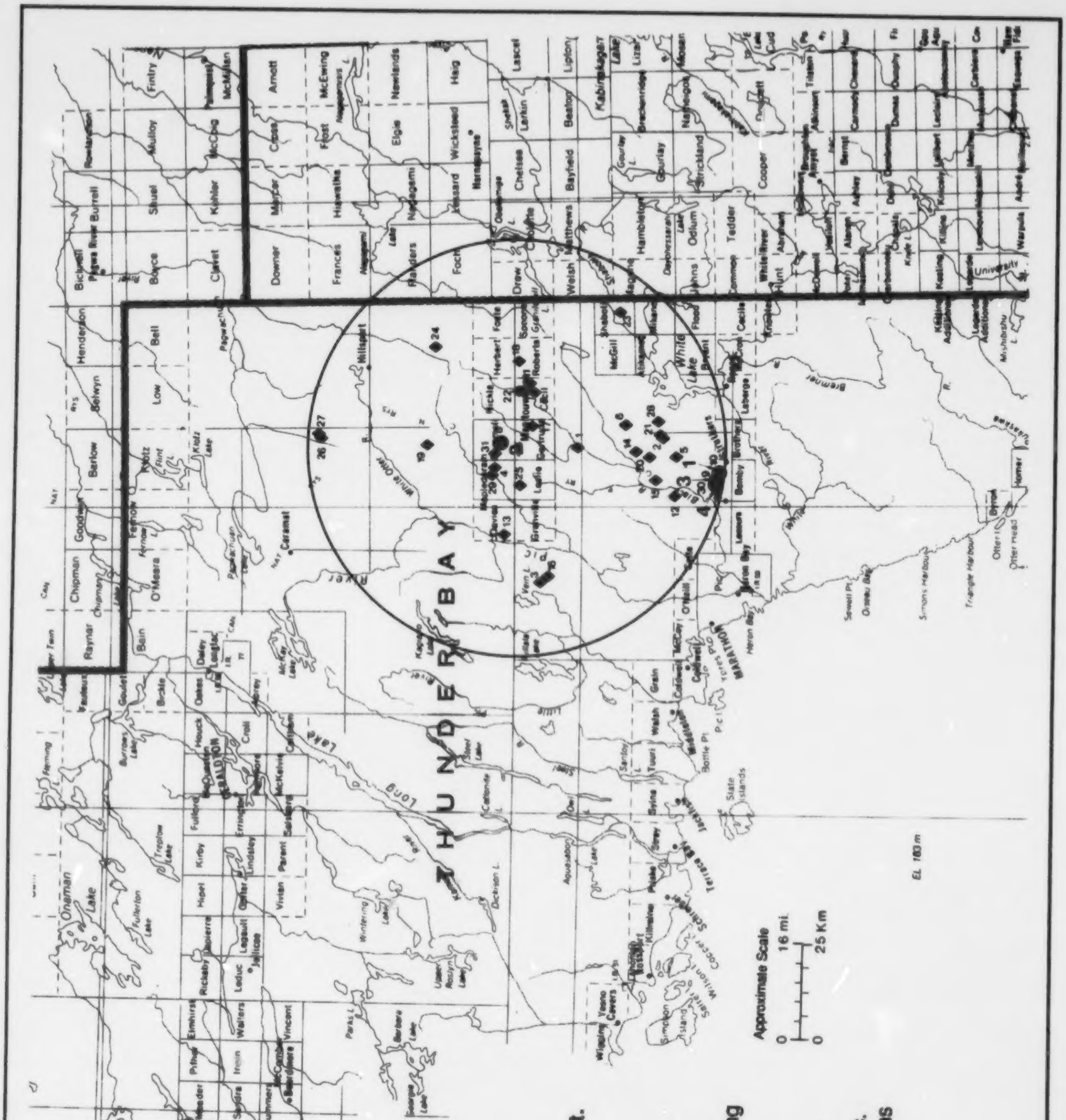
THUNDER BAY
Manitouwadge
Marathon
Schreiber
Terrace Bay
Geraldton
Long Lake
White Lake
Hemlo
Approximate Scale
0 16 mi.
0 25 Km
1
2
3
4

Figure 7.6.

Manitouwadge Mineral Resource Geologist Project.

EXPLANATION

● Producing Mines, 1991
1. David Bell Mine, Teck-Corona Operating Corporation
2. Geco Division, Noranda Inc.
3. Golden Giant Mine, Hemlo Gold Mines Inc.
4. Williams Mine, Williams Operating Corp.

◆ Property Visits, 1991 (keyed to Table 7.9)

Platinum-Group Elements(PGE)

Exploration for PGE mineralization in the Schreiber–Hemlo District should concentrate on the following parameters and characteristics:

1. mafic to ultramafic (dark coloured) intrusive rocks of Mesoproterozoic to Archean age

2. disseminated sulphide mineralization within the mafic to ultramafic intrusive rocks—generally less than 5% is sufficient (sulphide concentrations rich in copper are enriched in PGE in several areas within the Coldwell alkalic complex and elsewhere)

3. mafic or ultramafic rocks which display variations in grain size (i.e., fine grained to pegmatitic), modal layering, disrupted layering, intermixing of magma types, magmatic-related breccias and pegmatic dikes or veins

Any area which exhibits the above characteristics should be thoroughly prospected and sampled for PGE. Some potential areas to consider are the gabbroic rocks north of the Jackfish Lake–Empress Mine area, the eastern border gabbro of the Coldwell alkalic complex including areas south of the Dunlop occurrence, as well as the area east and west of Wullie Lake, the Goodchild Lake area and the Geordie–Coubran lakes area. The MacRae or Geordie Lake property of M. Joa and G. MacRae (Patterson et al. 1987) is still considered an excellent target for a large-scale, low-grade copper/palladium deposit. Further diamond-drilling programs to test for depth and strike extensions of the mineralized zone are warranted.

TABLE 7.9. Property Examinations—1991.

1. Agonzon Lake Mo occurrence
2. Armand Lake property
3. Baarts–Donaldson Cu occurrence
4. Big Nama Creek Mine[1,3]
5. East Barbara Lake sillimanite occurrence
6. Fairservice Zn occurrence
7. Faries Lake property
8. Geco Division Mine[1,2]
9. Golden Giant Mine[2]
10. Hemlo Highway Section
11. Ice Cream Lake Road sulphide occurrence
12. Kusins Pb-Zn occurrence
13. Labrador Cu occurrence
14. Lampson Road Cu-Zn occurrence[4]
15. Lenora–Argentex property
16. Lloyd Davis sulphide occurrence
17. Morley Lake Cu occurrence
18. Moshkinabi Lake property
19. Otter Lake sulphide occurrence
20. Pinegrove Lake property
21. Qued Resources property
22. Rawluk Lake property
23. Shabotik Cu-Ni-PGE occurrence[1]
24. Snake Pit sulphide occurrence
25. Swill Lake property
26. Taradale Cu-Ag occurrence
27. Taradale Lake graphite occurrence
28. Theresa Lake Cu occurrence[4]
29. Willecho Mine[1,3]
30. Williams Mine[2]
31. Willroy Mine[1,3]

[1] visited during the course of a field trip conducted in 1991
[2] current producer
[3] past producer
[4] new occurrence

THE MANITOUWADGE MINERAL RESOURCE GEOLOGIST PROJECT

Introduction

The Manitouwadge Mineral Resource Geologist Project was initiated in January 1991 to stimulate and facilitate mineral exploration within a 50 km radius of the township of Manitouwadge (Figure 7.6). The project, staffed by D. McKay, is scheduled to run for two years and operate in conjunction with the Schreiber–Hemlo Resident Geologist Program. Primary objectives include the compilation, research and investigation of new and previously known mineral occurrences in the Manitouwadge area; preparation of an Open File Report documenting these occurrences; provision of client services via property examinations, field trips, sample analyses and information dispersal; and provision of public education via prospecting classes, technical presentations and poster displays. Funding is provided by the four-year Canada-Ontario 1991 Northern Ontario Development Agreement (NODA), a subsidiary agreement to the Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario. It is hoped this project will increase the geological data base for the Manitouwadge area and possibly assist in the discovery of new mineral resources to replace those currently being depleted.

The project area includes both the Manitouwadge and Hemlo mining camps. Approximately 110 metallic and/or economic mineral occurrences are reported to exist in the area including 4 producing mines (the David Bell, Golden Giant and Williams mines in Hemlo, and the Geco Division Mine in Manitouwadge) and 3 past producers (the Big Nama, Willecho and Willroy mines near Manitouwadge).

Thirty-one property visits and two field trips were conducted in 1991 (*see* Table 7.9; Figure 7.7). A total of 313 grab, chip and channel samples were collected and submitted for multielement analysis to determine metal content and chemical alteration where applicable. Selected geological samples and assay results were presented in display format at

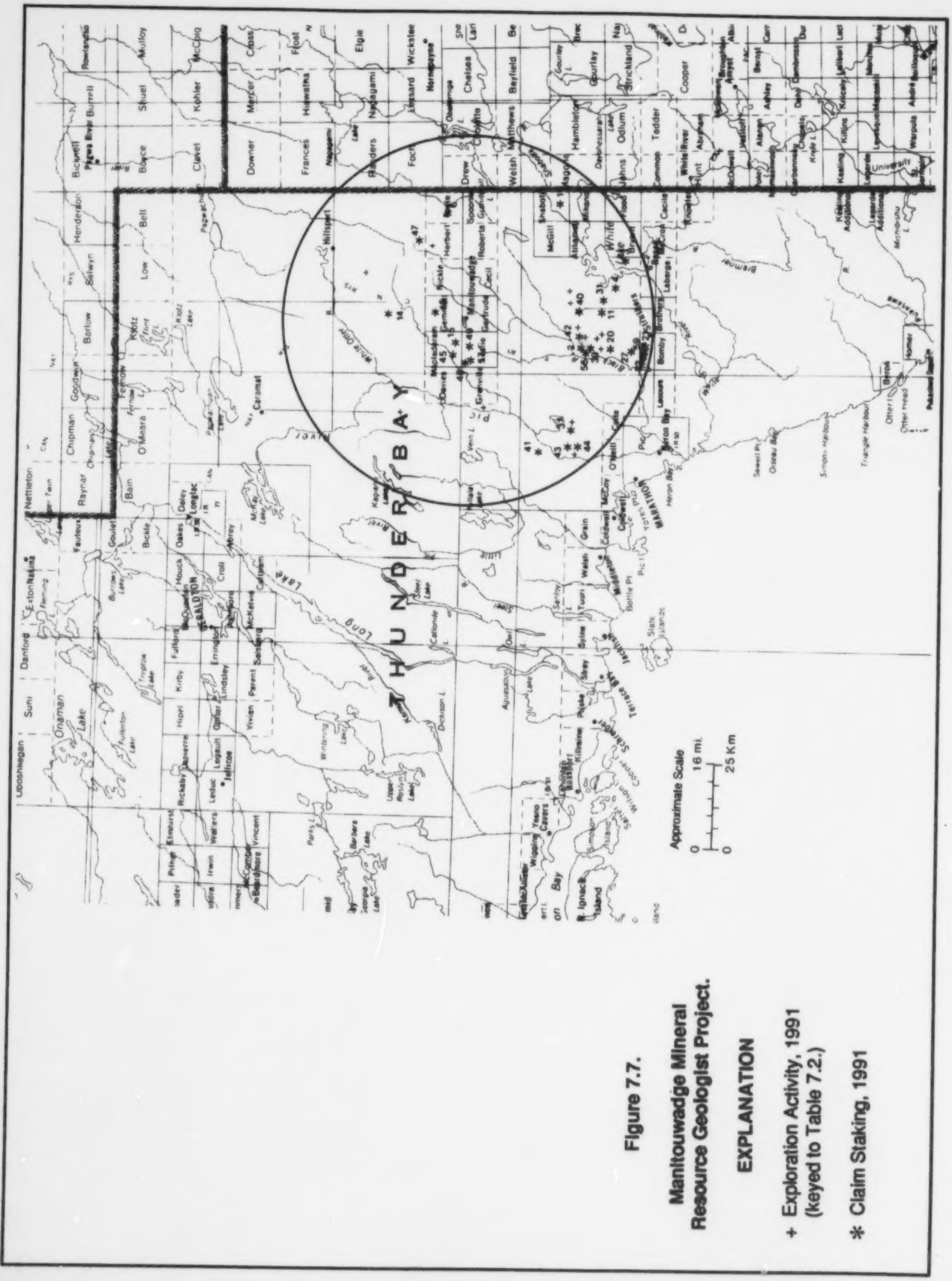
THUNDER BAY
GERALDTON
MARATHON
Manitouwadge
Long Lake
Onaman Lake
Caramat
Longlac
Jellicoe
Hillsport
White Otter
Pic R.
Heron Bay
Slate Islands
St. Ignace Island
Nipigon Bay
Schreiber
Terrace Bay
Jackfish
Rossport
White Lake
Approximate Scale
0
16 mi.
0
25 Km

Figure 7.7.

Manitouwadge Mineral Resource Geologist Project.

EXPLANATION

+ Exploration Activity, 1991 (keyed to Table 7.2.)

✻ Claim Staking, 1991

the Mines and Minerals Symposium held in Toronto during December 1991 and will be presented in April 1992 at the Northwestern Ontario Mines and Minerals Symposium to be held in Thunder Bay. An Open File Report documenting the metallic and/or economic mineral occurrences in the Manitouwadge area is scheduled for release in 1993. Information sessions for prospectors are scheduled to be held in Terrace Bay, Marathon and Manitouwadge during the spring of 1992. A prospecting course is scheduled to be held in Manitouwadge during February 1992.

Several interesting and previously undocumented mineral occurrences were discovered in the Manitouwadge area by prospectors in 1991. These include the Theresa Lake copper occurrence located on the northwest shore of Theresa Lake by Costy Bumbu and J. Martin (OPAP funded), and the Lampson Road copper-zinc occurrence located on the Lampson Road approximately 28 km south of Manitouwadge by B. Brinklow and L. Brinklow.

Acknowledgments

Numerous prospectors and geologists provided valuable information and assistance during the first year of this project. Exploration personnel from Geco Division (Noranda Inc.) and Noranda Exploration Company Ltd. provided access to proprietary information regarding mineral occurrences in the Manitouwadge area. H. Williams, B. Schnieders and M. Smyk conducted field trips introducing the author to the geology of the Manitouwadge area. T. Oja provided assistance in the field. B. Nelson provided technical support and lapidary services. B. Lucas drafted several of the figures. K. Fenwick, B. Schnieders and M. Smyk reviewed and edited the manuscript. C. Komar provided typing and word-processing support.

All analytical work was performed by the Temiskaming Testing Laboratory, Ministry of Northern Development and Mines, Cobalt.

Mining Activity

Mining activity in the Manitouwadge area (i.e., within a 50 km radius of the Township of Manitouwadge) is summarized in the Schreiber–Hemlo Resident Geologist's section of this report.

Exploration Activity

Mineral exploration in the Manitouwadge area in 1991 consisted of 25 active projects (Figure 7.1; Table 7.2). This represents a decrease in activity of approximately 16% from 1990. Of these 25 projects, 18 were base metal related, 6 were gold related and 1 was platinum-group element related. The Noranda Group (Hemlo Gold Mines Inc., Geco Division and Noranda Exploration Company, Ltd.) dominated exploration in the Manitouwadge area, accounting for approximately 72% of the active projects. Other exploration companies active in the Manitouwadge area included Granges Inc. and Newmont Exploration Ltd.

GOLD EXPLORATION

Gold exploration accounted for 24% of the 1991 exploration projects in the Manitouwadge area. Exploration for gold was restricted to the "North Limb" of the Hemlo greenstone belt, primarily in the vicinity of the Hemlo mines. A summary of the gold-exploration projects is provided in the Schreiber–Hemlo Resident Geologist's section of this report.

BASE-METAL EXPLORATION

Base-metal exploration accounted for 72% of the 1991 exploration projects in the Manitouwadge area. Exploration for base metals was focussed in four areas including the Theresa Lake area, Page Lake–Louis Lake–Huck Lake area, Dotted Lake–Lampson Road–Pinegrove Lake area and the Manitouwadge synform and surrounding area.

Prospectors C. Bumbu and J. Martin were active in the Theresa Lake area and have discovered a new copper occurrence on the northwest shore of Theresa Lake. Preliminary assay results have returned up to 1.7% Cu in grab samples of garnetiferous, mafic metavolcanic rocks (see "Property Examinations" section of this report). This exploration was funded by the Ontario Prospectors Assistance Program (OPAP). At the time of writing, the property was available for option.

Noranda Exploration Company, Ltd. was active in the Page Lake, Louis Lake and Huck Lake areas located approximately 15 km, 20 km and 30 km northeast of Marathon, respectively. Exploration programs were based on ground follow-up of the regional airborne geophysical survey flown by Noranda in 1989. Diamond drilling was conducted on the Louis Lake property.

Noranda Exploration Company, Ltd. was active in the Dotted Lake area. Line cutting, geological mapping, geophysical surveys (HLEM, MAG) and diamond drilling were performed on the Dotted Lake property. The Fairservice zinc occurrence, described by Milne (1968) and Schnieders et al. (1991), is located on this property. Approximately 500 m of diamond drilling was performed at four locations including the Fairservice zinc occurrence. Results of the drilling are not yet known.

Prospectors B. Brinklow and L. Brinklow were active in the Dotted Lake-Pinegrove Lake area and discovered a new copper-zinc occurrence on the Lampson road, approximately 1.4 km east of Highway 614 and 28 km south of Manitouwadge. Preliminary assay results have returned up to 1.34% Zn and 0.32% Cu in grab samples of sulphide-bearing, mafic metavolcanic and metasedimentary rocks (*see* "Property Examinations" section of this report). This discovery prompted the staking of numerous claims in the area, both by area prospectors and Noranda Exploration Company Ltd. At the time of writing, the Lampson road copper-zinc occurrence had been optioned by Noranda Exploration Company Ltd.

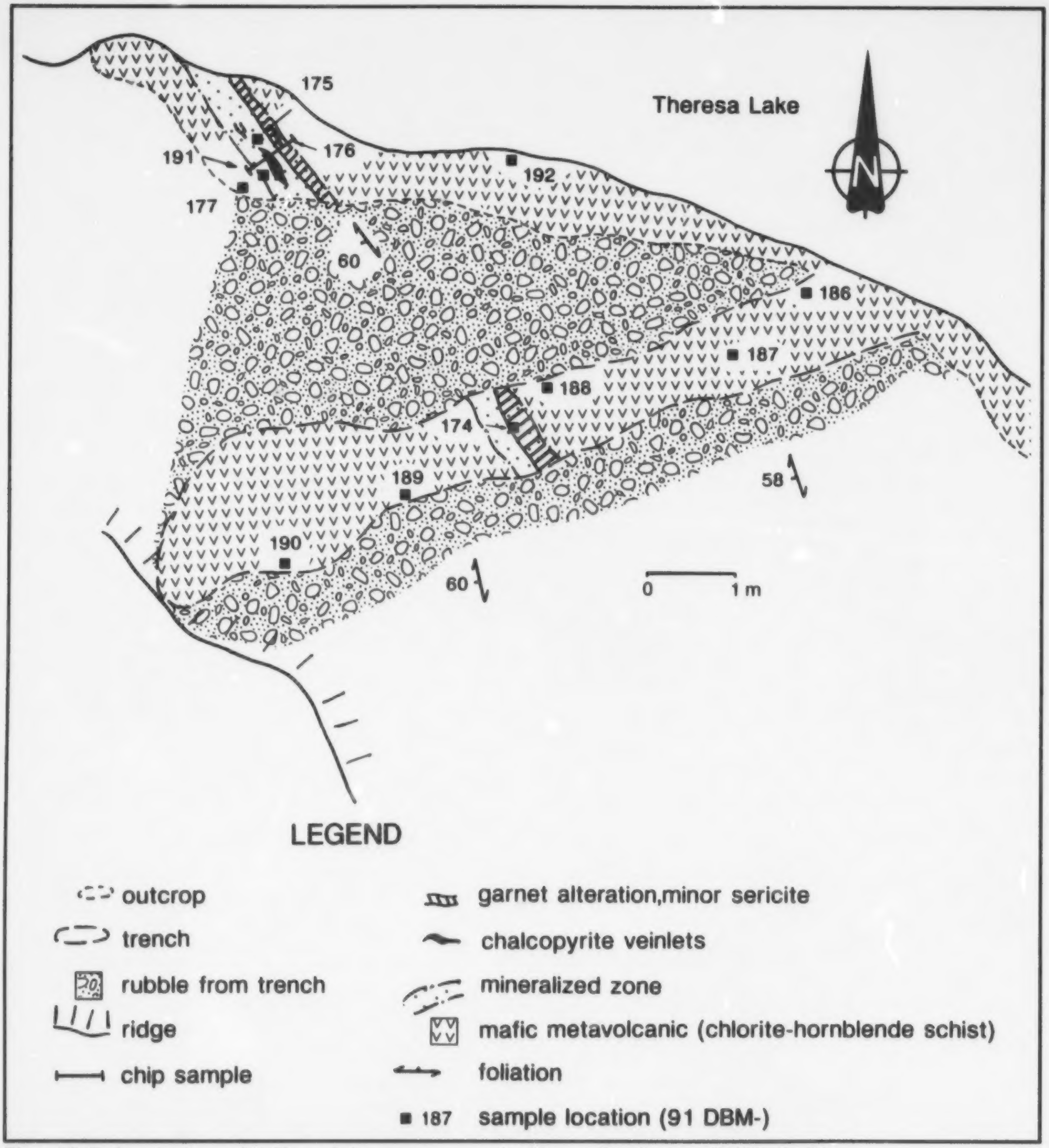
175
Theresa Lake
N
176
191
192
177
60
186
187
188
174
58
189
190
60
0
1 m
LEGEND
outcrop
trench
rubble from trench
ridge
chip sample
garnet alteration,minor sericite
chalcopyrite veinlets
mineralized zone
mafic metavolcanic (chlorite-hornblende schist)
foliation
■ 187 sample location (91 DBM-)

Figure 7.8. Geology sketch map of the Theresa Lake copper occurrence (*see* "Property Examinations—1991" for details).

A. Turner was active, stripping, sampling and prospecting his Pinegrove Lake property located west of, and adjacent to, the Lampson road copper-zinc occurrence. The property contains metavolcanic and metasedimentary rocks similar to those found on the Lampson road property. Recent assay results have returned up to 0.75% Zn, 0.32% Cu and 0.24 ounce Au per ton in grab samples collected from the property. At the time of writing, the property had been optioned by Noranda Exploration Company Ltd.

A. Turner continued exploration on his Swill Lake property in Leslie Township located approximately 9.5 km west of Manitouwadge. This included stripping, trenching, prospecting and sampling. The property contains garnetiferous amphibolite, sericite schist and sulphide-bearing units (Schnieders et al. 1991; Schnieders and Smyk 1990).

Geco Division (Noranda Inc.) and Noranda Exploration Company, Ltd. were active in the Manitouwadge synform and surrounding area. Exploration programs were based primarily on ground follow-up of the regional airborne geophysical survey flown by Noranda in 1989. Surface exploration was performed on six properties in the area. The majority of the work was performed on the One Otter Lake (East) property located approximately 25 km northeast of Manitouwadge in and around Herbert Township. Line cutting, geological mapping, geophysical surveys (MAG, VLF), stripping and geochemical sampling were performed on this property.

Granges Inc. was active in the Manitouwadge synform exploring its Central property located in eastern Mapledoram Township approximately 5 km northwest of Manitouwadge. A pulse EM geophysical survey and diamond drilling were conducted in 1991.

G. Goodwin and A. Turner were active in the Everest Lake area approximately 20 km north of Manitouwadge. Stripping, trenching, sampling and prospecting were performed on their Otter Lake property (see "Property Examinations" section of this report). Assay results have returned up to 0.16% Cu and 0.021 ounce Au per ton in iron-formation rich in pyrrhotite.

PLATINUM-GROUP ELEMENTS EXPLORATION

Exploration for platinum-group elements in the Manitouwadge area was restricted to one active exploration program. A deep EM geophysical survey was performed on G. Gionet's Shabotik copper + nickel + platinum-group elements property located in Shabotik Township (Schnieders and Smyk 1989). This work was funded by the Ontario Prospectors Assistance Program (OPAP).

Property Examinations

THERESA LAKE COPPER OCCURRENCE

Prospectors C. Bumbu and J. Martin have discovered a new copper occurrence on the northwest shore of Theresa Lake, approximately 32 km south-southeast of Manitouwadge. The occurrence was initially exposed as a result of low water levels in Theresa Lake. Subsequent stripping and trenching have further exposed the occurrence to examination.

The occurrence is located within the "North Limb" of the Hemlo greenstone belt, approximately 300 m south of the contact with the Dotted Lake batholith. Several narrow quartz-feldspar porphyry dikes occur immediately west of the occurrence. A small body of serpentinized peridotite is located approximately 100 m to the southeast.

The occurrence consists of sulphide mineralization hosted in strongly foliated (155/59SW) mafic metavolcanic rocks (*see* Figure 7.8). The mafic metavolcanics consist of dark green, fine- to medium-grained chlorite-hornblende schists. The sulphide mineralization consists of disseminated grains to stringers and patches of pyrrhotite, chalcopyrite and pyrite localized in zones oriented subparallel to the host-rock foliation. The mineralized zones vary from being weakly to strongly magnetic reflecting variations in pyrrhotite content. Sulphide "secretion injection structures", similar to those described by Smyk and Watkinson (1990), suggest the sulphides have undergone remobilization. Localized silicification and sericitization are associated with the mineralized zones. Subhedral garnet porphyroblasts, up to 1 cm in diameter, may locally compose up to 30% of this altered rock.

The main mineralized zone is 40 to 60 cm wide and has been exposed along strike for approximately 6 m. Limited stripping, approximately 20 m to the southwest, has exposed similar copper mineralization and a second subparallel zone of mineralization may exist. The main mineralized zone parallels the west shoreline of Theresa Lake.

Grab and chip sampling of the various rock units has returned the following assays (all samples returned less than 0.001% Pb) listed in table 7.10.

Pending the results of whole-rock analyses, the possibility exists that the main mineralized zone may represent an altered, narrow iron formation within the mafic metavolcanic sequence.

Other copper occurrences are located on the west shore of Theresa Lake. Barry (1983) reported assay results of up to 0.8148% Cu for mafic metavolcanic rocks taken from a 10 m wide zone of shearing and silicification located approximately 1.8 km south-southeast of the occurrence described above. If related, these occurrences may define a south-southeasterly trend of copper mineralization that extends for at least 1.8 km along the west shore of Theresa Lake.

LAMPSON ROAD COPPER—ZINC OCCURRENCE

Prospectors B. Brinklow and L. Brinklow have discovered a new copper-zinc occurrence on the Lampson road, approximately 1.4 km east of Highway 614 and 28 km south of Manitouwadge. Outcrop in the area parallels the road and is exposed intermittently for approximately 200 m. The occurrence is located on the south side of Lampson road approximately midway along the exposed section. Recent logging and road construction in the area have helped facilitate prospecting and exploration.

The occurrence is located within the "North Limb" of the Hemlo greenstone belt, approximately 700 m south of the contact with the Black–Pic batholithic complex. The Dotted Lake batholith is located approximately 5 km to the east. Numerous, narrow, felsic dikes have intruded and locally brecciated the rocks hosting the occurrence. Medium- to coarse-grained, relatively massive amphibolites in the area may represent subvolcanic gabbroic intrusions. The Fairservice zinc occurrence (Schnieders et al. 1991; Milne 1968) is located approximately 7.3 km east of the Lampson

TABLE 7.10. Assay results from the Theresa Lake copper occurrence.

Sample Number	Gold (oz./ton)	Silver (oz./ton)	Copper (%)	Zinc (%)	Nickel (%)
91DBM-174	0.003	nil	0.0735	0.0047	0.0109
91DBM-175	0.007	nil	0.2310	0.0026	0.0201
91DBM-176	trace	trace	0.6070	0.0043	0.0164
91DBM-178	0.012	trace	1.6920	0.0207	0.0052
91DBM-179	trace	nil	0.0123	0.0029	n.a.
91DBM-180	n.a.	n.a.	0.0020	n.a.	0.1020
91DBM-188	nil	nil	0.0352	0.0028	n.a.
91DBM-190	0.014	nil	0.0653	0.0041	n.a.
91DJM-14	trace	nil	0.0966	0.0014	0.0386

NOTE: n.a. - not assayed

Sample Descriptions

91DBM-174:	rusty, magnetic, siliceous, garnetiferous schist, disseminated and veinlet pyrrhotite and chalcopyrite, main trench (grab)
-175:	similar to 91DBM-174, shoreline exposure, 6 m north of main trench (grab)
-176:	50 cm chip across mineralized zone hosting 91DBM-175
-178:	rusty, chloritic hornblende schist, chalcopyrite as veinlets and localized patches, 20 m southwest of main trench
-179:	quartz-feldspar porphyry dike, 15 m west of main trench (grab)
-180:	massive, coarse-grained, serpentinized peridotite, shoreline exposure, 400 m southeast of main trench (grab)
-188:	unmineralized chlorite-hornblende schist, main trench, 0.5 m east of mineralized zone (grab)
-190:	chlorite-hornblende schist, <1% pyrrhotite and chalcopyrite, main trench, 3 m west of mineralized zone (grab)
91DJM-14:	amphibolitic metagabbro, 2 to 3% pyrite and pyrrhotite as disseminated grains, fracture fillings and foliation parallel veinlets, 200 m southeast of main trench (grab)

road copper-zinc occurrence and is hosted in a narrow, banded iron formation within a mafic flow sequence.

The Lampson road occurrence consists of erratically distributed sulphides hosted in intercalated mafic metavolcanic and metasedimentary rocks. The mafic metavolcanics consist of fine- to medium-grained, moderately to locally strongly foliated (94/70S), dark gray-green, chlorite-hornblende schists. The metasediments consist primarily of folded and faulted oxide-facies banded iron formation. Anhedral garnet porphyroblasts, up to 5 mm in diameter, may locally comprise up to 10% of the iron formation rich in magnetite. The metasediments form a band approximately 10 m wide within the volcanic sequence. A rusty, pyritic, biotite-sericite schist occurs within a 30 cm wide shear zone located near the metavolcanic-metasedimentary contact. Numerous narrow, foliation-parallel and crosscutting quartz and quartz-epidote veins and veinlets occur in the area.

The sulphide mineralization appears confined to the iron formation and proximal mafic metavolcanics. The mineralized zone is approximately 40 cm wide and has been traced for 5 m. The sulphides have undergone remobilization and generally constitute less than 1% of the rocks in which they occur. Fine-grained pyrite and chalcopyrite occur as very thin coatings along fractures and foliation planes within the iron formation. Sphalerite appears confined to the mafic metavolcanics where it occurs in thin, erratically distributed, foliation-parallel seams and isolated patches associated with quartz.

Grab sampling of the various rock units has returned the following assays:

Sample Number	Gold (oz./ton)	Silver (oz./ton)	Copper (%)	Zinc (%)
91DBM-25	trace	nil	0.0296	0.0044
91DBM-32	nil	nil	0.0064	0.0176
91DBM-148	trace	nil	0.0592	0.0027
91DBM-149	nil	nil	0.3250	0.0028
91DLB-01	nil	nil	0.0049	1.3400
91DLB-03	0.002	nil	0.0119	0.0035

Sample Descriptions

91DBM-25:	rusty, sheared biotite-sericite schist, 1% pyrite as disseminated grains and localized patches
-32:	8 cm wide quartz-epidote vein hosted in banded iron formation
-148:	rusty, oxide-facies banded iron formation, 1% pyrite localized along foliation planes, trace chalcopyrite
-149:	rusty, oxide-facies banded iron formation, <1% fine-grained chalcopyrite localized along foliation planes and fractures
91DLB-01:	rusty, moderately foliated chlorite-hornblende schist, 2 to 3% medium-grained, red-brown sphalerite localized in quartz-filled fractures
-03:	rusty, oxide-facies banded iron formation, <1% fine-grained disseminated pyrite

Other base-metal occurrences and gossans occur within the "North Limb" of the Hemlo greenstone belt proximal to the contact with the Black-Pic batholithic complex (Schnieders et al. 1991; Siragusa and Chivers 1986; Milne 1968). The recent discovery of the Lampson Road copper-zinc occurrence serves to re-emphasize the potential of this area to host base metal mineralization.

TARADALE COPPER-SILVER OCCURRENCE

The Taradale copper-silver occurrence is located in the Upper Taradale Lake area approximately 49 km north-northeast of Manitouwadge and 5.75 km east-northeast of Stevens, a Canadian National Railway stop. The occurrence is situated 200 m south of the mainline of Canadian National Railway in the vicinity of mileage marker 55. This occurrence is within the Beardmore–Geraldton Resident Geologist's District.

Mineralization in the area was noted as early as 1954. At this time, the occurrence was known as the Dunkley copper showing. Assay values of up to 12% Cu were reported for grab samples taken from chalcopyrite-bearing quartz veins (Resident Geologist's files, Schreiber–Hemlo District, Thunder Bay). In 1965, the occurrence was mapped and briefly described by Coates (1966, 1968) who termed it the Taradale copper occurrence. Subsequent stripping and trenching by prospectors and exploration companies yielded well-mineralized vein material containing up to 12.25% Cu and 4.25 ounces Ag per ton (Bayne 1971). The occurrence was drilled in the early 1970s but details are not known as no information was submitted for assessment credit. During the present examination of the occurrence, two drill hole collars were located. Poorly mineralized diamond-drill core was found abandoned on the property.

The occurrence is located within the Quetico Subprovince and is spatially associated with a northwest-trending, linear topographic feature referred to as the Taradale lineament (Bayne 1971). In the vicinity of the occurrence, a diabase dike has intruded along this lineament. The occurrence is situated proximal to the contact between this dike and granite and granite gneiss located to the southwest. The dike is truncated along its northeast margin by a 15 m to 20 m high scarp and associated low-lying swamp. As a consequence, the northeastern contact of the dike is not exposed. The maximum exposed width of the dike is approximately 22 m.

The occurrence consists of erratically distributed sulphides hosted in narrow, coarse-grained quartz-carbonate veins. The veins vary in width from 5 mm to 25 cm. Several of the wider veins display a "crack-seal" texture defined by narrow mafic seams within the veins. Angular mafic xenoliths of wall rock up to 1 cm in size occur proximal to some of the vein margins. The veins parallel the Taradale lineament, strike 315° to 320° and dip vertically. The majority of the veins occur within the diabase. One mineralized vein was located in the contact zone between the diabase and granite gneiss. Another vein occurs within the granite gneiss itself. Individual veins display marked vertical and horizontal variations in size and degree of mineralization. The wall rock adjacent to the veins is commonly sheared and locally brecciated, silicified and carbonatized with calcite. The sulphide mineralization consists primarily of erratically distributed, coarse-grained anhedral patches and seams of chalcopyrite up to 4 cm in width. Minor amounts of bornite and trace amounts of fine-grained pyrite were observed in some of the veins. Fine-grained malachite and azurite commonly occur along fracture and foliation planes within the veins and host rocks. Bayne (1971) reported the occurrence of argentite and native silver but none was observed during the present examination. The diabase may locally contain 2% to 3% fine- to medium-grained, disseminated and patchy pyrrhotite.

A total of seven pits, varying in size up to 6 m long by 2 m wide by 2.5 m deep, were located on the occurrence. The pits are irregularly distributed along a 400 m zone parallel to the diabase-granite gneiss contact. They expose mineralized and unmineralized quartz veins and define a zone of copper mineralization approximately 50 m wide and 220 m long centred along the diabase-granite gneiss contact. For reference purposes, the pits have been numbered sequentially from the northwest to the southeast. Copper mineralization, as exposed in the pits, appears to increase towards the southeast. The veins exposed in pits No.5 and No.6 contained the richest copper mineralization.

Grab sampling of the various rock units has returned the following assays listed in table 7.11.

Field observations and assay results indicate the copper and silver mineralization is primarily restricted to the quartz-carbonate veins. As noted by Coates (1968), the location of the veins appears to be controlled by post-diabase faulting proximal to the dike margin.

Other copper occurrences, spatially related to northwesterly trending lineaments, occur in the Manitouwadge area (Coates 1968, 1970). To date, the economic potential of these occurrences has been limited by the erratic distribution and grade of the exposed mineralization. At the time of writing, the Taradale copper-silver occurrence was not staked.

OTTER LAKE SULPHIDE OCCURRENCE

The Otter Lake sulphide occurrence is located in the Everest Lake area approximately 20 km north of Manitouwadge and 8.5 km east-northeast of Everest Lake. The occurrence is best exposed approximately 610 m east of Otter Lake and 750 m northeast of Adze Lake (Coates 1968, Map 2141). The occurrence is accessible via recently constructed logging roads. A spur line of the Canadian National Railway is located approximately 4.5 km to the east.

The area surrounding the occurrence has been explored sporadically by prospectors and exploration companies since the early 1950s. Sulphides were first noted in the area as early as 1954. Chellew Gold Mines Limited performed exploratory drilling and surface trenching on the occurrence in 1955. Six holes, totalling 748 m, were drilled (assessment files, Resident Geologist's Office, Schreiber–Hemlo District, Thunder Bay). Although assay data is not available, the results of the drilling are reported to have been disappointing (*The Northern Miner*, May 31, 1956, Resident Geologist's files, Schreiber–Hemlo District, Thunder Bay). Sulphide mineralization in the area was noted by Coates (1968) and Williams and Breaks (1990). The occurrence is currently held and is being explored by prospectors G. Goodwin and A. Turner of Manitouwadge.

During the present examination of the occurrence, six pits varying in size up to 4 m long by 1.5 m wide by 1.5 m deep and two drill-hole collars were located. Several deteriorated boxes of poorly mineralized diamond-drill core were found abandoned on the property.

TABLE 7.11. Assay results from the Taradale copper-silver occurrence.

Sample Number	Gold (oz./ton)	Silver (oz./ton)	Copper (%)	Zinc (%)
91DBM-83	nil	1.49	2.7900	0.0093
91DBM-84	trace	trace	0.0310	0.0145
91DBM-85	trace	trace	0.5650	0.0047
91DBM-86	nil	nil	0.0181	0.0111
91DBM-87	nil	0.42	1.6700	0.0046
91DBM-88	0.002	trace	0.0256	0.0093
91DBM-89	nil	nil	0.0039	0.0006
91DBM-90	nil	nil	0.0403	0.0014

Sample Number	Co (%)	Cr (%)	Ni (%)	Pb (%)
91DBM-83	0.0026	0.0027	0.0054	0.0023
91DBM-84	n.a.	n.a.	0.0086	0.0025
91DBM-85	0.0012	0.0029	0.0030	0.0013
91DBM-86	n.a.	n.a.	0.0071	0.0019
91DBM-87	n.a.	n.a.	0.0043	0.0014
91DBM-88	n.a.	n.a.	0.0050	0.0022
91DBM-89	n.a.	n.a.	n.a.	0.0014
91DBM-90	n.a.	n.a.	n.a.	0.0016

NOTE: n.a. - not assayed

Sample Descriptions

91DBM-83: 15 cm wide, coarse-grained, gray-white quartz-carbonate vein, 10% chalcopyrite, hosted in diabase, pit No.5 (grab)
-84: dark green, massive, medium-grained, silicified, weakly magnetic diabase, <1% fine-grained disseminated pyrrhotite, host to 91DBM-83, pit No.5 (grab)
-85: 20 cm to 25 cm wide, coarse-grained, milky-gray quartz-carbonate vein, 2 to 3% coarse-grained chalcopyrite, numerous small, angular, mafic fragments, hosted in diabase, pit No.5 (grab)
-86: diabase host to 91DBM-85, similar to 91DBM-84 but less siliceous, pit No.5 (grab)
-87: 20 cm wide quartz-carbonate vein, 3% to 5% coarse-grained chalcopyrite, pit No.6, 36 m southeast of pit No.5 (grab)
-88: diabase host to 91DBM-87, similar to 91DBM-84, pit No.6 (grab)
-89: massive to gneissic, very coarse-grained, non-mineralized granite pegmatite, pit No.3, 156 m northwest of pit No.6 (grab)
-90: rusty, malachite-stained, 7.5 cm wide quartz-carbonate vein hosted in granite pegmatite, pit No.3 (grab)

The occurrence is located within the Quetico Subprovince approximately 2.5 km north of the Quetico–Wawa Subprovince boundary. An east-trending, linear topographic feature referred to as the Little Nama Lake lineament (Coates 1968) is located approximately 180 m north of the occurrence. A northwest-trending fault transects Otter Lake and has offset sinistrally, by approximately 150 m, the mineralized horizon hosting the occurrence (Williams and Breaks 1990). The mineralized horizon is hosted in hornblende-biotite paragneiss and associated migmatite. Intrusion of granite has resulted in the development of localized *lit-par-lit* structures. Refolded minor folds in paragneiss indicate multiple episodes of deformation. Medium-grained, brown orthopyroxene occurs locally within migmatite indicating granulite-grade metamorphism has affected the area. Several northwest-trending, coarse-grained, porphyritic diabase dikes occur south and west of the occurrence.

The occurrence consists of coarse-grained sulphides erratically distributed in a 2 to 4 m wide mineralized zone rich in quartz. The mineralized zone has been traced for approximately 2 km, trends approximately 080° and dips steeply south. Minor local variations in the trend of the mineralized zone occur. The sulphide mineralization consists primarily of coarse-grained, massive to disseminated, subhedral grains of pyrite, pyrrhotite and rare chalcopyrite. Although local concentrations of up to 80% sulphides occur, the sulphides generally constitute 5% to 10% of the mineralized zone. Triple junctions in pyrite and numerous, rounded, sulphide-supported quartz clasts suggest the sulphides have undergone recrystallization and remobilization. A thick, rusty gossan has developed on the occurrence. Supergene processes have lead to the development of localized, surficial deposits of crustiform pyrite and marcasite. Locally derived regolith has been recemented with hematite and limonite. Prominent, narrowly spaced, horizontal joints occur within the mineralized zone but were not observed in surrounding migmatite. The mineralized zone varies from being weakly to locally strongly magnetic, reflecting variations in pyrrhotite content. Narrow, gray-white quartz veins and pods occur locally in the migmatite surrounding the mineralized zone. The northern contact of the mineralized zone with surrounding migmatite is locally sheared.

Grab and channel sampling of the various rock units has returned the following assays listed in table 7.12.

Field observations suggest the mineralized zone may represent a deformed and metamorphosed, silicate-facies iron formation locally rich in sulphide. Similar rocks occur on the west side of Little Nama Lake, located approximately 1.4 km to the west, and may represent the westward extension of the iron formation hosting the Otter Lake sulphide occurrence. Other sulphide occurrences, some copper-bearing, occur in the area between, and to the north of, Otter Lake and Little Nama Lake (Coates 1968; Williams and Breaks 1990).

BAARTS-DONALDSON COPPER OCCURRENCE

The Baarts-Donaldson copper occurrence is located in the Vein Lake area approximately 32 km west of Manitouwadge and 6 km southeast of Vein Lake. The occurrence is best exposed approximately 250 m west of the northwest corner of Little Joe Lake. The occurrence is accessible via a well maintained trapline trail which begins on the west shore of the Pic River, opposite the terminus of the Julia Lake road, and extends westward to Vein Lake.

TABLE 7.12. Otter Lake sulphide occurrence assay results.

Sample Number	Gold (oz./ton)	Silver (oz./ton)	Copper (%)	Zinc (%)	Nickel (%)
91DGG-01	0.009	nil	0.0840	0.0100	n.a.
91DGG-02	0.007	nil	0.0780	0.0088	n.a.
91DGG-08	trace	trace	0.1360	0.0076	n.a.
91DGG-09	0.004	nil	0.0205	0.0023	n.a.
91DBM-45	nil	trace	0.1224	0.0028	0.0024
91DBM-49	nil	nil	0.1532	0.0052	0.0272
91DBM-107	nil	trace	0.1585	0.0039	n.a.
91DBM-158	0.004	n.a.	0.0155	n.a.	n.a.
91DBM-160	0.021	n.a.	0.0276	n.a.	n.a.
91DBM-162	0.003	n.a.	0.0048	n.a.	n.a.

NOTE: n.a. - not assayed

Sample Descriptions

91DGG-01:	rusty, coarse-grained, massive sulphides, primarily pyrite with finer-grained pyrrhotite, rare chalcopyrite, pit No.2 (grab)
-02:	rusty, coarse-grained massive sulphides, similar to 91DGG-01, pit No.2 (grab)
-08:	rusty, gray and pink, massive quartz-feldspar pegmatite, <1% pyrite, trace chalcopyrite, pit No.4 (1 m channel)
-09:	rusty, weakly foliated iron formation, 3% to 5% fine- to medium-grained sulphides, 400 m west of pit No.4 (grab)
91DBM-45:	rusty, sand rich in sulphide, approximately 85% pyrite, pit No.4 (grab)
-49:	rusty, medium- to coarse-grained massive sulphides, 80% pyrite, 10% pyrrhotite, strongly magnetic, pit No.6, southwest shore Otter Lake (grab)
-107:	extensively weathered, rusty black, iron formation rich in sulphide, 30% to 40% coarse-grained pyrite and pyrrhotite, pit No.4, (1 m channel)
-158:	rusty, migmatized biotite gneiss, trace pyrite, pit No.5 (0.5 m channel)
-160:	rusty, migmatized biotite gneiss in contact with iron formation, 30% pyrite and pyrrhotite pit No.5 (1 m channel)
-162:	rusty, migmatized biotite gneiss, crudely layered, <1% fine-grained pyrite as disseminated grains, pit No.5 (1 m channel)

The area surrounding the occurrence has been explored sporadically by prospectors and exploration companies starting in 1955. Trenches in the area expose a narrow zone of copper mineralization that can be traced for approximately 2.5 km, trending 310°. Chip samples taken across the mineralized zone exposed immediately west of Little Joe Lake assayed 5.02% Cu, 0.25% Zn and 0.30 ounce Ag per ton over 5 m (Hawkins 1971). A ground electromagnetic survey performed by Kerr Addison Mines Ltd. in 1965 did not indicate the presence of any conductors in the area (Coates 1970). In 1965, A. Knapp drilled four holes totalling approximately 288 m in the vicinity of Little Joe Lake but failed to intersect any significant mineralization (Coates 1970). The most recent work on record consists of mechanical stripping and trenching performed in 1972 by prospector E. Starr (assessment files, Resident Geologist's office, Schreiber–Hemlo District, Thunder Bay).

During the present examination of the occurrence, five trenches varying in size up to 7.0 m long by 2 m wide by 1 m deep were located and sampled. The trenches were distributed irregularly along, or proximal to, a major fault in the area.

The occurrence is hosted primarily in pink, coarse-grained granite and granitic gneiss. Local lenses and pods of migmatized, mafic metavolcanic rocks and quartz-feldspar pegmatite are also present. The occurrence is spatially associated with the northwest-trending Little Joe Lake fault. Northeast-trending bands of amphibolitized mafic metavolcanic gneisses occur southeast and northwest of the occurrence.

The occurrence consists primarily of erratically distributed sulphides and associated weathering products hosted in narrow zones of altered, sheared and brecciated granite and granitic gneiss. The location of the mineralization appears to be controlled by the Little Joe Lake fault and/or related parallel faults. All of the copper mineralization exposed in the trenches was confined within, or adjacent to, these faults. The mineralized zones examined varied in width from approximately 1 m to 4 m. In a 3 m high cliff exposure located approximately 250 m west of Little Joe Lake, the mineralized zone dips steeply southwest and widens with depth. The sulphide mineralization consists primarily of fine- to medium-grained, disseminated grains of pyrite and coarser-grained anhedra and blebs of chalcopyrite. The sulphides tend to be concentrated in zones rich in quartz and may locally constitute up to 5% of the host. Azurite and malachite staining are common within the mineralized zones. Veinlets of chalcocite and covellite are reported to occur within some of the mineralized zones (Hawkins 1971) but none were observed during the present examination. The host granite and granitic gneiss are locally strongly silicified and hematitized. Several narrow veinlets of fine-grained, foliation-parallel specular hematite occur adjacent to the main mineralized zone exposed just west of Little Joe Lake.

Grab sampling of the various rock units has returned the following assays listed in table 7.13.

Hawkins (1971) concluded that the Baarts-Vein Lake property possessed favourable economic potential and that insufficient work has been performed in exploring it at depth. Hawkins (1971) recommended that a deep-penetrating EM survey and diamond drilling were warranted in order to fully assess the potential of the area. To the author's knowledge, these recommendations have never been acted upon. B. Dawd, co-discoverer of the Geco orebody and one of the first prospectors to examine the Baarts-Donaldson occurrence, felt the area surrounding the occurrence had great potential (B. Dawd, Prospector, personal communication, 1991). At the time of writing, the Baarts-Donaldson occurrence was not staked.

Recommendations for Exploration

General recommendations regarding exploration for gold, base metals and platinum group elements are presented in the Schreiber–Hemlo Resident Geologist's section of this report. Additional valuable recommendations specific to the Manitouwadge area are given in previous annual reports of the Schreiber–Hemlo Resident Geologist.

Recently released regional lake sediment and water geochemical data (Friske et al. 1991a, 1991b) define several gold and base-metal anomalies in the Manitouwadge area that cannot be accounted for by known mineralization. Although anomalous levels of metals in lake sediments may be attributable to a variety of sources (Friske 1991), including anthropogenic input (man-made contamination), the possibility of proximal, undiscovered mineralization should not be dismissed. When used in conjunction with other geological data, regional lake-sediment geochemical anomalies can help define areas suitable for ground follow-up programs. Several of the anomalies noted by Friske et al. (1991) are discussed in following sections of this report.

GOLD

Hemlo Area

Gold mineralization in the Hemlo area is spatially related to metavolcanic-metasedimentary contacts, deformation zones and porphyry contacts and is characterized by the presence of sericite schists, disseminated pyrite, molybdenite, green mica, barite and pervasive potassic alteration (Schnieders et al. 1991). Exploration for gold in and around the Hemlo area

TABLE 7.13. Assay results from the Baarts–Donaldson occurrence.

Sample Number	Gold (oz./ton)	Silver (oz./ton)	Copper (%)	Zinc (%)
91DBM-132	trace	nil	0.3780	0.0008
91DBM-133	trace	nil	0.8140	0.0034
91DBM-134	0.003	trace	3.4200	0.0046
91DBM-135	trace	nil	0.0240	0.0018
91DBM-136	nil	nil	0.3110	0.0091
91DBM-137	nil	nil	0.5690	0.0010
91DBM-139	nil	nil	0.3580	0.0014
91DBM-140	nil	nil	0.0070	0.0016
91DBM-142	trace	trace	0.3960	0.0026
91DBM-144	nil	nil	0.4320	0.0026

Sample Descriptions

91DBM-132: rusty, brecciated, vuggy, hematitized granite gneiss, <1% fine- to medium-grained chalcopyrite as disseminated grains, rare bornite, trench No.1, approximately 475 m east of Little Joe Lake (grab)

-133: gray-white composite quartz vein, approximately 15% angular, granitic xenoliths, 2% to 3% chalcopyrite as irregular blebs up to 3 mm in size, trench No.2, approximately 250 m west of Little Joe Lake (grab)

-134: rusty, purple, hematitized and brecciated granite gneiss, abundant malachite, trace sulphides, pit No.2 (grab)

-135: pink-brown, massive, unaltered granite gneiss, trace medium-grained pyrite, host to mineralized zone, pit No.2, (grab)

-136: rusty, weakly foliated granite gneiss, stained with malachite, proximal to southwest contact of mineralized zone, pit No.2 (grab)

-137: rusty, purple, hematitized, silicified, brecciated granite gneiss, trace chalcopyrite, malachite stained, pit No.3, 60 m east of pit No.2, (grab)

-139: altered, brecciated granite gneiss similar to 91DBM-137, pit No.3 (grab)

-140: massive, pink, coarse-grained granite gneiss, host to mineralized zone, up to 20% specular hematite in narrow subparallel veinlets up to 3 cm wide, pit No.4, 25 m west of pit No.1 (grab)

-142: mottled, purple, hematitized, silicified, vuggy, brecciated granite gneiss, minor malachite, no visible sulphides, pit No.5, approximately 1 km west of pit No.2 (grab)

-144: altered, brecciated granite gneiss similar to 91DBM-142, cut by narrow quartz veins containing irregular blebs of chalcopyrite up to 5 mm in size, pit No.5 (grab) should continue to focus on these features. Felsic, quartz-porphyritic intrusive and volcanic rocks appear to have a close spatial relationship with gold mineralization in the Hemlo area. Accordingly, the presence of such rocks is considered indicative of high-potential areas.

Theresa Lake-Dead Otter Lake Area

The "North Limb" of the Hemlo greenstone belt, which includes the Theresa-Dotted lakes area, contains several gold occurrences hosted in a variety of lithologic units. Schnieders et al. (1991) reported 0.05 ounce Au per ton in pyritic quartz porphyry collected from the Theresa Lake area. Siragusa (1985) reported 8850 ppb Au in gossany, fine-grained, clastic mafic metasediment collected approximately 3 km west of Theresa Lake. Recent assays of pyritic, sericite schists collected from the Armand Lake property, located approximately 2.9 km west of Theresa Lake, have returned up to 0.086 ounce Au per ton (Resident Geologist's files, Schreiber–Hemlo District, Thunder Bay).

As noted by Schnieders et al. (1991), exploration for gold in the Theresa Lake-Dotted Lake area should focus on strongly deformed and altered (silicified, carbonatized, sericitized, pyritized) rocks. The contact of the metavolcanic-metasedimentary sequence with the Dotted Lake batholith to the north and the Musher Lake pluton to the south warrants exploration. Areas surrounding sulphide-bearing, quartz- and feldspar-phyric rocks should be prospected carefully. Siragusa (1985) concluded that thin units of chert-magnetite ironstone and fine-grained, clastic metasediments contain more gold than other lithologic types present in the Theresa Lake area. These rocks should not be overlooked as exploration targets. Prospectors B. Fowler and M. Shuman have recently discovered pyritic, green mica-bearing, quartz-eye, sericite schists on their Armand Lake property. The similarity between these rocks and those associated with the Hemlo deposit warrants further exploration for gold in this area.

Manitouwadge Area

The area surrounding the town of Manitouwadge was first explored in the early 1930s by prospectors searching for gold (Thomson 1933). The discovery of base-metal orebodies in the early 1950s resulted in the Manitouwadge area being labelled a base-metal camp. As a consequence, little exploration for gold has occurred in the area during the last 40 years.

Although no significant gold occurrences have been discovered in the Manitouwadge area, amphibolite-facies, pyritic, sericite-muscovite schists do occur (Pye 1960; Friesen et al. 1982). Similar rocks are known to host the Hemlo orebody and, therefore, these more traditional base-metal targets in the Manitouwadge area should be explored for their gold potential.

Pyritic, quartz-eye, sericite schists have been discovered on A. Turner's Swill Lake property located approximately 9.5 km west of Manitouwadge. Preliminary assays have returned up to 0.002 ounce Au per ton (Resident Geologist's files, Schreiber–Hemlo District, Thunder Bay). The presence of anomalous concentrations of gold in this area warrants further investigation.

A narrow band of feldspar- and/or quartz-feldspar-porphyritic, felsic intrusive rocks occurs approximately 200 m north of Manitouwadge Lake (Milne 1974). This unit is locally sulphide bearing and should be examined to determine its gold potential.

Gold is reported to occur in the Foch River occurrence located in Foote Township along the Foch River approximately 4.5 km southeast of Foch Lake (Giguere 1972). The presence of numerous felsic and mafic intrusions, faults and sulphide mineralization warrants further exploration for gold in this area.

Low gold values are associated with many of the known sulphide occurrences in the Manitouwadge area. Biotite-gneiss rich in sulphide from the Otter Lake sulphide occurrence (*see* "Property Examinations" section of this report), for example, assayed up to 0.021 ounce Au per ton. All sulphide occurrences in the Manitouwadge area, especially those located proximal to or within fault and/or shear zones, should be examined to determine their gold potential.

Lake-Sediment Gold Anomalies

The regional lake sediment geochemistry maps of Friske et al. (1991a, 1991b) indicate several gold anomalies in the Manitouwadge area. Although some of these anomalies, such as those surrounding the Geco orebodies, can be accounted for by known mineralization, others cannot. In addition to the anomalies mentioned in the Schreiber–Hemlo Resident Geologist's section of this report, these include anomalies located east of Flanders Lake (42F/16NW), south and west of Agonzon Lake (42F/04SW), adjacent to Gaby Lake (42C/12NW), northwest and east of Kwinkwaga Lake (42C/14SW), southeast of and around Tocheri Lake (42F/3SE) and centred around Manitouwadge. Detailed maps showing specific sample locations are available (Friske et al. 1991a, 1991b).

The anomaly located east of Flanders Lake is of particular interest as it is associated with coincident strong arsenic and weak antimony anomalies. A moderate molybdenum anomaly also occurs in the area. Arsenic, antimony and molybdenum are often associated with gold mineralization and are commonly used as pathfinder elements for gold. It is strongly recommended that the area east of Flanders Lake in the vicinity of Leigh station on the Canadian National Railway be thoroughly investigated to determine the cause of these anomalies. Prospecting may be difficult as much of the area is covered with overburden (Milne 1964).

The anomalies located northwest and east of Kwinkwaga Lake and southeast of Tocheri Lake warrant investigation. The area around Kwinkwaga Lake is shown to be underlain by a small, north-trending belt of mafic to intermediate metavolcanic rocks on the Bedrock Geology of Ontario Map 2543 (OGS 1991). The same map shows the area southeast of Tocheri Lake to be underlain by migmatized supracrustal rocks. Hornblende amphibolite from the Olivier occurrence located approximately 4 km southeast of Tocheri Lake has returned assay values of up to 0.01 ounce Au per ton and 0.31 ounce Ag per ton (Giguere 1972).

BASE METALS

The discovery of the Manitouwadge base-metal mining camp has proven that caution and a fair bit of patience are required when assessing mineral showings in amphibolite-facies terranes. The Manitouwadge area (50 km radius of Manitouwadge) has a history of unimpressive-looking mineral occurrences. In addition, deformation, metamorphism and hydrothermal alteration have acted to obscure high-potential rocks, thus, making exploration targets difficult to identify. It is suggested that all sulphide occurrences in the Manitouwadge area, regardless of size or lateral extent, be fully investigated to determine their base-metal potential.

Numerous base-metal occurrences exist within the Manitouwadge area. These occurrences are hosted in a variety of lithologic types within several distinct geological environments. Volcanogenic massive sulphide (VMS) deposits occur proximal to the town of Manitouwadge and are currently being mined for copper and zinc (Pye 1960; Milne 1974; Friesen et al. 1982). Orthomagmatic copper and copper-nickel occurrences are located within the Coldwell and Killala Lake alkalic complexes (Milne 1967; Coates 1970) in the Goodchild Lake area (Milne 1967) and within Shabotik Township (Schnieders and Smyk 1989). Vein-hosted copper-silver occurrences exist in the Vein Lake and Taradale Lake areas (Coates 1968, 1970). To date, economic concentrations of base metals have only been found in the VMS deposits located within the Manitouwadge synform.

Areas considered to have high potential for base-metal mineralization include the Page Lake area, the Theresa Lake-Dotted Lake-Black River area and the Manitouwadge area (i.e., the area enclosing the Manitouwadge synform including possible eastward and westward extensions of the Manitouwadge stratigraphy).

As noted by Schnieders et al. (1991), sillimanite, cordierite, garnet and anthophyllite (gedrite) are associated with many of the VMS deposits in the Manitouwadge camp and are indicative of hydrothermal alteration and/or high-grade metamorphism. These minerals are considered positive indicators for base-metal mineralization and exploration should focus on their detection. Lithogeochemical surveys to detect sodium and calcium depletion, and magnesium, potassium, zinc and copper enrichment, are considered valuable exploration tools for identifying VMS-related alteration in the Manitouwadge area (Schnieders et al. 1991). Since most of the base-metal orebodies in the Manitouwadge camp are hosted in muscovite-quartz schist, the presence of this lithology is considered a positive indicator for base-metal mineralization.

Page Lake Area

Sulphide-bearing, felsic metavolcanic rocks occur in contact with mafic metavolcanic and metasedimentary rocks in the Page Lake area located approximately 45 km southwest of Manitouwadge and 6 km east of Bamoos Lake (Milne 1967).

Reconnaissance investigations in the Page Lake area in 1989 identified sulphide gossans on the north shore of a small lake situated approximately 750 m west of the north end of Page Lake (Schnieders and Smyk 1990). A number of EM conductors occur in the area (assessment files, Resident Geologist's Office, Schreiber–Hemlo District, Thunder Bay). The regional lake sediment geochemistry maps of Friske et al. (1991a) show copper, zinc and lead anomalies in the area around Page Lake.

Assay values of up to 0.08 ounce Au per ton and 1.16% Zn over 5.5 m are reported for sulphide-bearing, felsic metavolcanic drill core from the Knut Kuhner occurrence located approximately 1.6 km east of the Pic River in the vicinity of Page Lake (assessment files, Resident Geologist's Office, Schreiber–Hemlo District, Thunder Bay).

The possibility exists that VMS base-metal deposits may occur in the Page Lake area. Further prospecting and sampling in this area is strongly recommended.

Theresa Lake–Dotted Lake–Black River Area

Several base-metal occurrences and numerous sulphide occurrences exist within the "North Limb" of the Hemlo greenstone belt in the vicinity of Theresa and Dotted lakes and in the metavolcanic-metasedimentary sequence extending west and south of Dotted Lake towards the Black River. These occurrences have been documented by Milne (1968), Barry (1983), Siragusa (1985) and Siragusa and Chivers (1986).

Encouraging new discoveries by prospectors (see "Property Examinations" section of this report) further illustrate the potential of Theresa Lake-Dotted Lake-Black River area to host base-metal mineralization. Sulphide-bearing, locally garnetiferous, amphibole schist from the Pinegrove Lake property located approximately 7 km west of Dotted Lake returned assay values of up to 0.75% Zn. Banded, oxide-facies, iron formation and garnetiferous, mafic metavolcanic schist from the Lampson road copper-zinc occurrence located approximately 5 km west of Dotted Lake returned assay values of up to 0.325% Cu and 1.34% Zn respectively. Rusty, chloritic hornblende schist from the Theresa Lake copper occurrence located on the northwest shore of Theresa Lake returned assay values of up to 1.692% Cu.

Some of the base-metal occurrences in the Theresa Lake-Dotted Lake-Black River area, including the Fairservice zinc occurrence (Schnieders et al. 1991) and the Theresa Lake copper occurrence (*see* "Property Examinations" section of this report), possess some of the mineralogical and geochemical characteristics commonly associated with VMS deposits. These include the presence of alteration minerals such as garnet, biotite and sericite and, in the case of the Fairservice zinc occurrence, a depleted sodium content. Schnieders et al. (1991) concluded that many of the occurrences in the area are syngenetic, but have vein-like features due to intense deformation and subsequent sulphide remobilization.

The Theresa Lake-Dotted Lake-Black River area is considered to have high potential for base metals. Further prospecting and sampling in this area is strongly recommended. The contacts of the metavolcanic-metasedimentary sequence with the Black Pic batholithic complex, and the Dotted Lake, Musher Lake and Cedar Lake plutons and contacts between the metavolcanic and metasedimentary units warrant thorough examination. All sulphide occurrences should be examined for base-metal mineralization and/or possible hydrothermal alteration.

Manitouwadge Area

Numerous sulphide and base-metal occurrences exist within the Manitouwadge synform proximal to the town of Manitouwadge (Pye 1960; Milne 1974). Many of these occurrences display mineralogical, geochemical, and textural characteristics commonly associated with Archean VMS deposits. Consequently, the Manitouwadge synform and the extensions of the Manitouwadge stratigraphy into Gemmell, Nickle and Herbert townships, as well as to the north of those townships, are considered high-potential areas for base-metal exploration. Unfortunately, the metavolcanic-metasedimentary limbs of the synform have been extremely disrupted and intensely deformed and subjected to amphibolite grade metamorphism and hydrothermal alteration. Identification of these rocks as exploration targets is therefore difficult. Since most of the known base-metal occurrences in the Manitouwadge area are hosted in muscovite-quartz schist and are associated with sillimanite, cordierite, garnet and anthophyllite (gedrite), the presence of these minerals is considered to be a positive indicator of high potential for base-metal mineralization.

The Bedrock Geology Of Ontario Map 2543 (OGS 1991) shows migmatized supracrustal rocks to underlie the northern portions of Gemmell, Mapledoram and Davies townships and to extend west-southwest of Davies Township to Killala Lake. The possibility exists that inliers of the Manitouwadge mine series stratigraphy may occur in this area. Exploration for base metals is therefore warranted. Specific target areas include the Michal-Fakeloo lakes area and the Little Joe-Vein lakes area.

Coates (1968, 1970) has mapped metavolcanic and metasedimentary migmatites in the vicinity of Michal and Fakeloo lakes approximately 30 km northwest of Manitouwadge. Geophysical anomalies, some of which were ascribed to sulphide mineralization, occur in the Michal-Fakeloo lakes area (Resident Geologist's files, Schreiber–Hemlo District, Thunder Bay). This area should be investigated to determine its base-metal potential.

Several sulphide occurrences and copper occurrences exist in the Little Joe-Vein lakes area located approximately 32 km east of Manitouwadge. These include the Baarts-Donaldson copper occurrence (see "Property Examinations" section of this report) and the Lloyd Davis sulphide occurrence (Coates 1970). It is recommended that all sulphide occurrences in these areas be thoroughly examined to determine their base metal potential. Prospecting should focus on discovering the source of the copper mineralization now localized in northwest-trending faults in the area.

A large lead anomaly is shown located northeast of Obakamiga Lake approximately 55 km east of Manitouwadge on the Regional Lake Sediment Geochemistry Map of Friske et al. (1991b). Williams and Breaks (1990) have mapped sulphide-bearing mafic metavolcanic rocks in this area. It is recommended that this area be explored to determine the source of the lead anomaly. All sulphide occurrences in the area should be thoroughly examined to determine their base-metal potential.

Platinum-Group Elements

Exploration for platinum-group element (PGE) mineralization in the Manitouwadge area (50 km radius of Manitouwadge) should focus on areas underlain by mafic and ultramafic intrusive rocks. Such rocks occur in many locations within the Manitouwadge area including the Shabotik Township area, the Moshkinabi-Faries lakes area, the Goodchild Lake area, the Coldwell alkalic complex, and the Killala Lake alkalic complex. Characteristics considered indicative of PGE mineralization include the presence of disseminated sulphides (typically less than 5%), variations in grain size, modal layering, disrupted layering, intermixing of magma types, magmatic-related breccias and pegmatitic dikes or veins (Schnieders and Smyk 1990). Any mafic or ultramafic rocks displaying any of these characteristics, especially those which are sulphide-bearing, warrant thorough examination for PGE mineralization.

Since mafic and ultramafic rocks are commonly moderately to strongly magnetic, examination of existing magnetic survey maps may help define potential target areas for PGE mineralization. The Kwinkwaga Lake Aeromagnetic Map 2179G (ODM-GSC 1963), for example, shows several high magnetic anomalies located in and around Shabotik Township located approximately 35 km southeast of Manitouwadge. The Shabotik copper + nickel + platinum-group elements occurrence (Schnieders and Smyk 1989) is located in this area, and the possibility exists that other occurrences may be nearby. Of particular interest are seven small, elliptical magnetic anomalies located around Bulldozer Lake. Bulldozer Lake is located approximately 5 km northwest of the Shabotik copper + nickel + platinum-group elements occurrence and is underlain by rocks of similar composition and texture to those that host the Shabotik copper + nickel + platinum-group elements occurrence (Bennett et al. 1987). As a consequence, it is strongly recommended that the Bulldozer Lake area be thoroughly prospected and sampled for PGE mineralization.

Recent mapping by Williams and Breaks (1989, 1990) has identified mafic, layered intrusive rocks in the Moshkinabi-Faries lakes area located approximately 22 km east of Manitouwadge. Peridotite, gabbro and anorthosite occur in the area and several sulphide occurrences have been noted (Williams and Breaks 1990). Some of these mafic rocks appear to be very similar in composition and texture to rocks hosting PGE mineralization in Shabotik Township located approximately 25 km to the southeast (Williams and Breaks 1990; Schnieders et al. 1991). A sample of very coarse-grained, pyritic metagabbro collected adjacent to the Ice Cream Lake road approximately 3.8 km northeast of Faries Lake returned assay values of 0.019 ounce Au per ton, 0.39 ounce Ag per ton, 0.47% Cu, 15 ppb Pd and less than 1 ppb Pt (Resident Geologist's files, Schreiber-Hemlo District, Thunder Bay). The presence of copper mineralization and disseminated sulphides in mafic rocks in this area warrants exploration for PGE. Recent logging activity has exposed numerous outcrops and increased access to the area.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

1. R.H. Sutcliffe (Associate Professor, University of Western Ontario, London), E.C. Walker (Research Associate, University of Western Ontario, London) and R.W. Hodder (Professor, University of Western Ontario, London) have begun the first year of a three-year mapping and research program on the Coldwell alkalic complex (Walker et al. 1991). The objectives of the project are producing a 1:20 000-scale geologic map of the complex, developing models of processes that have concentrated rare elements, base and precious metals and investigating the petrogenesis of alkalic magmatism during the process of continental rifting.

2. Map sets that will accompany T.L. Muir's Hemlo tectono-stratigraphic report (in prep.) were released in December (Muir 1991a, 1991b). Open File maps 181 and 182 at a scale of 1:5000 depict local lithologic and structural features in the vicinity of the Hemlo gold deposit.

GEOLOGICAL SURVEY OF CANADA ACTIVITIES (FIGURE 7.3)

1. D.F. Graham and C. Bowie (Canada Centre for Remote Sensing (CCRS)/INTERA Information Technologies) and K.L. Ford (Airborne Geophysics Section, Geological Survey of Canada (GSC)) initiated a co-operative effort promoting digital-data integration studies to help demonstrate the various types and uses of remotely sensed data. One of the first projects involved the collection and manipulation of digital data collected over the Coldwell alkalic complex and along the north shore of Lake Superior.

   A synthetic-aperture radar (SAR) survey was flown along the north shore of Lake Superior in 1990; a portion of the SAR image is shown in Figure 7.9. As described by Graham and Grant (1991), SAR data assist in the interpretation of many varied geologic features. The image in Figure 7.9 is centered on the Coldwell alkalic complex which has greater relief and more deeply dissected topography than the surrounding Archean rocks which are overlain by thicker amounts of glacial till.

   Lineaments are manifested by glacial and structural features. Southwesterly directed ice flow produced glacial-fluted crag-and-tail hills north of the Coldwell complex near Martinet Lake for example. Structural lineaments are developed in east-northeast-trending, intercalated metavolcanic and metasedimentary rocks and foliation-parallel faults near Ripple. Prominent fault-line scarps, such as the Little Pic River valley and other deeply incised valleys, are abundant in the Coldwell complex. Tone and textural variations may provide information on surface materials, vegetation and morainal topography. This is best exemplified locally by relatively smooth glaciofluvial-glaciolacustrine deposits infilling the valleys of the Pic and Prairie rivers. Cultural features such as highways, powerlines and townsites are also evident.

   Airborne gamma-ray spectrometer data collected by the GSC and airborne SAR data acquired by CCRS were combined to show how digital image processing can be used to provide ground control for the spectrometric data. A uranium-thorium-potassium ternary enhancement map was produced and compared to regional geology to generate sites for detailed ground follow-up.

   A field program was coordinated with Resident Geologist's Office staff to better understand local geology and compare radiometric measurements with observed geologic features. Over 180 field measurements were taken using a portable gamma-ray spectrometer to check out radioactive anomalies, including those related to physiographic features (Graham and Ford 1991). The publication of the digital integration techniques that create enhanced-image products is planned for the near future.

2. Under the direction of P.B. Holman, the Airborne Geophysics Section conducted a regional combined airborne gamma-ray spectrometric, total field magnetic and VLF-EM survey along the north shore of Lake Superior with a 1 km line spacing. Areas flown in 1991 included the completion of NTS sheet 42D/14, started in 1990, as part of a similar survey over the Coldwell alkalic complex to the east, and sheets 42E/3 and 42E/2 (west half). The area around Winston and Big Duck lakes was infilled at a line spacing of 500 m. Over 3000 line-kilometres were flown in 1991, providing additional coverage to surveys flown in 1989 in the Georgia Lake area (42E/4, 42E/5, parts of 52H/1 and 52H/8) and in the Terrace Bay-Heron Bay-Hemlo area in 1990 (42D/9, 42D/10, 42D/14, 42D/15, 42D/16, parts of 42C/12 and 42C/13). These surveys were flown to evaluate the regional and detailed mapping (bedrock and surficial) and mineral exploration applications of airborne gamma spectrometry.

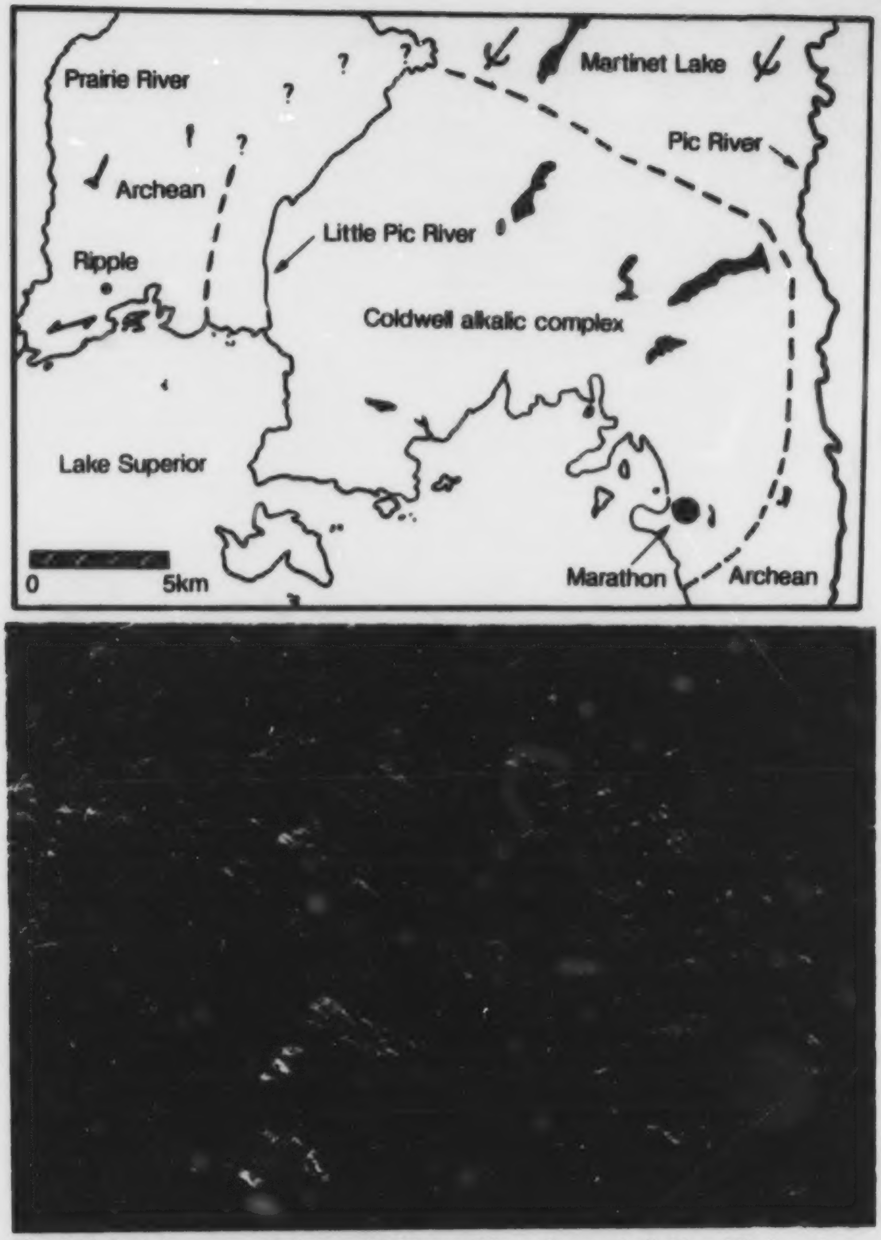

Figure 7.9. Synthetic-aperture radar image and index map of the area between the Prairie and Pic rivers. *See* text for explanation. Photograph courtesy of D.F. Graham, Canada Centre for Remote Sensing, Ottawa, Ontario.

3. K.L. Ford of the Airborne Geophysics Section conducted reconnaissance geological follow-up studies of airborne gamma ray spectrometric surveys in the Nipigon (52H/1), Cypress Lake (42E/4) and Santoy Lake (42D/15) areas and in the Coldwell alkalic complex. Field results confirmed the strong radioelement patterns outlined by the airborne data over parts of the Quetico Subprovince and the Coldwell complex and in both cases, identified minor uranium and thorium mineralization. Results demonstrate that where sufficient radioelement contrasts exist, these geophysical surveys are an excellent predictive mapping tool which can be used to subdivide complex metasedimentary schist-migmatite-intrusive granitoid terrains and complex intrusive sequences.

4. B.W. Charbonneau of the Airborne Geophysics Section carried out geological follow-up studies in the vicinity of the Hemlo gold mines. A well-defined potassium anomaly, approximately 2.5 km in length, was indicated by the 1990 airborne survey. This anomaly lies directly over the main Hemlo deposit and further west

in the vicinity of the Williams Mine "C" zone and the "North" and "South" mineralized zones on the former Golden Sceptre property of Hemlo Gold Mines Inc. Potassic alteration at Hemlo is manifested in the extensive development of microcline, muscovite/sericite and biotite in the gold-ore rich in molybdenum. Potassium values, measured by *in situ* gamma-ray spectrometry, increase from less than 2% potassium in unaltered rocks to greater than 4% potassium in potassium-altered metasedimentary rocks and quartz-feldspar porphyry (Moose Lake/Golden Sceptre porphyry) over a maximum width of 200 m. Maximum values of 10% potassium occur locally within the gold-mineralized zone. Similar work was carried out in the Red Lake area with the objective of demonstrating that gamma ray spectrometry is a viable exploration technique for potassium metasomatism associated with gold mineralization.

5. I. Kettles of the Terrain Sciences Division initiated drift geochemical and surficial geological studies in the Manitouwadge area. Objectives of the project include completion of surficial geological mapping for the Manitouwadge area, production of drift geochemistry maps and development of useful drift prospecting techniques. To date, approximately 300 till samples were collected over parts of NTS map sheets 42C/13, 42E/01, 42E/08 and 42F/03 to /06. The majority of the samples were collected over the first three of these map sheets. Some Quaternary mapping was undertaken where there is road access in the Vein Lake area. Funding for this project is provided by the Canada-Ontario 1991 Northern Ontario Development Agreement (NODA).

6. E. Zaleski of the Continental Geoscience Division initiated a bedrock geological study of the Manitouwadge area. The objective of the project is to improve knowledge of alteration, metamorphism, structure and mineralization in and around the Manitouwadge base-metal camp.

   Emphasis will be placed on:

   a) determination of primary setting, identification of protoliths to alteration and metamorphism and documenting features of synvolcanic alteration and mineralization;

   b) structural geology and interpretation of the complex map pattern of lithologic units;

   c) tectonometamorphic overprinting, mineralogy and features of metamorphic fluid migration;

   d) timing of metamorphism, deformation and magmatism; and

   e) compilation and synthesis of previous and current work in the area.

   During the 1991 field season, 1:5000 scale mapping and sampling were done on the southern limb of the Manitouwadge synform, west of the Geco deposit. This will be extended to the rest of the synform in subsequent field seasons and supplemented by examination of drill core. The co-operation of mining and exploration companies active in the area, including Noranda Minerals Inc., Granges Inc. and Minnova Inc., is critical to the success of this project. Funding is provided by the Canada-Ontario 1991 Northern Ontario Development Agreement (NODA).

7. Several National Geochemical Reconnaissance lake sediment and water data reports were released in 1991 by the GSC. Open File reports 2360 and 2362 (Friske et al. 1991a, 1991b) cover NTS areas 42D and 42E south, and 42C and 42F south, respectively. These reports contain data for gold and 25 other elements obtained by reanalyzing lake-sediment samples collected in 1978.

ONTARIO GEOSCIENCE RESEARCH GRANT PROGRAM

M.E. Fleet (Professor, University of Western Ontario, London) and Y. Pan (Research Associate, University of Western Ontario, London) completed their metamorphic petrology of the White River gold prospect near Hemlo (Pan and Fleet 1991). Their final report has been released as Ontario Geological Survey Open File Report 5776 (Fleet and Plan 1991).

E.S. Schandl (University of Toronto), D.W. Davis (Royal Ontario Museum, Toronto), M.P. Gorton (University of Toronto) and H.A. Wasteneys (Royal Ontario Museum, Toronto) initiated a study of the geochronology of hydrothermal alteration around volcanic-hosted, massive sulphide deposits in the Superior Province. Sampling and study of the Winston Lake Division and Geco Division mines were conducted to investigate the relative timing of host-rock deposition and alteration, and the geochemical characteristics of the alteration assemblages (Schandl et al. 1991).

G. Southam, M. Mackenzie (University of Guelph), W.S. Fyfe (University of Western Ontario, London) and T.J. Beveridge (University of Guelph) conducted an evaluation of the stability of metal-cyanide complexes in the presence of cyanide-hydrolysing bacteria. The tailings of Golden Giant Mine at Hemlo were studied as part of this project.

UNIVERSITY THESES

J. Grant (MSc candidate, Queen's University, Kingston) is conducting a tectono-stratigraphic study in the Hemlo area.

S. Osterberg (PhD candidate, University of Minnesota, Duluth) is conducting a stratigraphic-alteration study of the Winston Lake stratigraphy near Schreiber.

C. Shaw (PhD candidate, University of Western Ontario, London) is mapping and researching the genesis and mineralization of the eastern gabbro on the border of the Coldwell alkalic complex.

G. Shore (MSc candidate, University of Western Ontario, London) is mapping and researching the genesis of the alkalic gabbro and its relationship to undersaturated syenites in the Coldwell alkalic complex.

G. Dubuc (BSc candidate, University of Western Ontario, London) is studying the magnetic susceptibility anisotropy of the eastern gabbro and ferroaugite syenite of the Coldwell alkalic complex, under the supervision of H.C. Palmer (Professor, University of Western Ontario, London).

R. Penczak (BSc candidate, University of Waterloo) is studying the petrology and mineral chemistry of the Middleton western gabbro-hosted copper occurrence in the Coldwell alkalic complex.

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8. Northwestern Ontario Industrial Minerals Program—1991

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INTRODUCTION

The "Industrial Minerals" program was initiated in March 1991 to monitor and stimulate exploration, development and production of industrial minerals in northwestern Ontario. This program is jointly funded by the four-year CANADA-ONTARIO 1991 Northern Ontario Development Agreement, a subsidiary agreement to the Economic Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario.

The primary objectives of the program are: 1) to document and investigate new and previously known industrial mineral occurrences; 2) to provide client services via property visits, sample analyses and information exchange; 3) introduce public education through prospector classes, oral presentations and poster displays; and 4) increase awareness of northwestern Ontario industrial minerals at technical seminars, workshops and conferences.

ACKNOWLEDGMENTS

This report was edited by K.G. Fenwick. M.C. Smyk provided assistance on a number of property visits in the Schreiber–Hemlo District and supplied invaluable information on the geology of the Coldwell alkalic complex. C. Komar reviewed this report and provided professional and efficient secretarial support throughout the year along with S. Warren. B. Nelson, Assistant Drill Core Library Geologist, was responsible for the preparation of the voluminous samples required by this program. Assistance in the field and office was provided by B. Lucas, whose efforts are gratefully appreciated. Numerous company representatives, prospectors and Ministry of Northern Development and Mines staff provided invaluable information and field assistance on occurrences in northwestern Ontario.

MINING ACTIVITY

Industrial mineral production in northwestern Ontario in 1991 is summarized in Table 8.1. The location of the producing quarries are shown on Figures 8.1a and 8.1b.

Granite Dimension Stone

Nelson Granite Limited and Granite Quarriers (G.Q.I.) Incorporated continued to produce from their quarries located in Docker Township, 12 km west of Vermilion Bay. The quarries produce a homogeneous, medium-grained, pink granite from a granite plug, which is part of the Dryberry batholithic complex. Fracturing in the granite is negligible, allowing for removal of blocks of any size.

Granite Quarriers (G.Q.I.) Incorporated produced approximately 300 m^3 (10000 cubic feet) of pink granite from May to August. Rough blocks produced from the quarry are shipped to fabrication plants in eastern Canada and the eastern United States (A. Probyn, Granite Quarriers (G.Q.I.) Incorporated, personal communication, 1991), to be manufactured into monument and architectural stone.

Nelson Granite quarries the Dryberry pink granite year-round. Production figures for 1991 are not available. However, in 1990 over 5550 m^3 (185000 cubic feet) was produced (Zielinski 1991). Approximately 2100 m^3 was fabricated on-site, mostly into monuments and monument bases; some custom work is done as well. The remainder was produced as rough blocks and shipped to their fabrication plants in eastern Canada and elsewhere to be made into monuments and architectural products.

Ballast Stone

Two railway ballast quarries were in operation from April to September in northwestern Ontario. Broda Construction Inc. of Kamsack, Saskatchewan operated both. At Canadian National Railway's Watcomb quarry, located 50 km southeast of Sioux Lookout, a 17 man crew produced over 5000 tons per day of crushed mafic metavolcanic rock. Total production this summer exceeded 500000 tons (C. Broda, Broda Construction Inc., personal communication, 1991). Two sizes were produced: less than 2 inches (<5 cm) for fill between wooden ties, and greater than 2 inches (>5 cm) for fill between concrete ties. This quarry is scheduled to close within 2 years, after 20 years of production.

This summer near Dyment, 42 km southeast of Dryden, at a Canadian Pacific Railway ballast quarry, a 21 man crew

CANADA
ONTARIO
Minerals • Minéraux

This project is funded under the Northern Ontario Development Agreement (NODA), a subsidiary agreement to the Canada-Ontario Economic and Regional Development Agreement.

Table 8.1. Industrial mineral producers and seasonal producers—1991.

Producer	Location	Commodity	Products/Production
1. A.J. Wing and Sons Construction Ltd./ L.T.L. Contracting Ltd.	MacGregor Township	diabase	soil erosion control, construction material
2. Nelson Granite Ltd.	Docker Township Vermilion Bay	pink granite	rough blocks, slabs, curbing specialty items; 5500 m^3 (1990)
3. Granite Quarriers (G.Q.I.) Inc.	Docker Township Vermilion Bay	pink granite	rough blocks for monuments; 300 m^3
4. Crystal Quarries Ltd.	south of Eagle Lake	white quartz	crushed quartz for use in a smelter, precast panels, landscaping stone; 18000 tons produced
5. Thorgrimson, F.	Eagle Lake	soapstone	carving stone; 3 tons
6. Canadian National Railways	Watcomb	ballast	crushed mafic metavolcanic rocks for railway ballast; 500000 tons
7. Canadian Pacific Railways	Dyment	ballast	crushed metavolcanic rocks for railway ballast; 400000 tons

was contracted to produce 400 000 tons of crushed intermediate metavolcanic rock. This quarry has sufficient reserves to provide ballast for the next 40 years.

Quartz

Crystal Quarries Limited, owned by Ted Hansen of Keewatin, operated a quartz quarry south of Muskeg Bay, Eagle Lake. Crystal Quarries was contracted to supply a total of 10 000 tons of crushed quartz for use in a new smelter to be constructed in East Selkirk, Manitoba. Limex Incorporated of Winnipeg was sub-contracted to quarry, crush and screen (¾ to 4 inches/2.0 to 10 cm) the quartz for shipment. Material under the ¾ inch (2.0 cm) minimum size requirement was bagged and shipped by Mr. Hansen to the United States for use in precast terrazzo tiles and as landscape stone (T. Hansen, Crystal Quarries Limited, personal communication, 1991).

Diabase

A.J. Wing and Sons Construction Limited operated a diabase quarry in MacGregor Township, just east of the Thunder Bay city limits. Approximately 8000 tons of crushed diabase was taken from stockpiled material for use in soil erosion projects. No new material was produced this year. However, plans are to resume blasting and crushing in the new year (Don Wing, A.J. Wing and Sons Construction Limited, personal communication, 1991).

In the past, diabase from the quarry was used for the production of mineral wool insulation, for construction purposes and as riprap.

Soapstone

P. Thorgrimson of Keewatin removed approximately 3 tons of soapstone from the waste dump of the past-producing Grace Mining Company quarry, located on Eagle Lake. Thorgrimson and his father, Frank, carve animal figurines and aboriginal ceremonial pipes. The soapstone occurrence is described by Kennedy and Sherlock (1989).

EXPLORATION ACTIVITY

Exploration activity for industrial minerals in northwestern Ontario is summarized in Table 8.2. The sites of exploration are indicated on Figures 8.1a and 8.1b.

Granite Dimension Stone

Numerous sites across northwestern Ontario were targets of exploration for granite dimension stone. The bulk of the exploration was concentrated on rocks north of Kenora. A few sites in the Thunder Bay area, and one site northeast of Marathon, were also investigated.

In the Kenora area, Palin Granite Canada Inc. continued to investigate a green granite on its Direct Lake property in the Lount Lake area. G. Zebruck of Kenora was contracted by Palin Granite to oversee construction of a 5 km access road to the property and the extraction of test blocks for market testing (G. Zebruck, personal communication, 1991).

North of Kenora, the Assin Partnership hired a consultant to evaluate the dimension stone potential of granite deposits

Table 8.2. Exploration activity—1991.

Number on Figure 8.1	Individual or Company (Location)	Activity
1.	Palin Granite Canada Inc. (Lount Lake area) (Direct Lake property)	road construction, test block removal, bulk sample testing, beneficiation studies, ASTM beneficiation studies, ASTM testing[1]
2.	Assin Partnership (Swan Lake I.R. 29) (Cygnet Lake) (Beaver Lake)	diamond drilling, test block removal, sample tiles produced, ASTM testing[1], market evaluation
3.	Assin Partnership (Islington Lake I.R. 29)	diamond drilling
4.	Assin Partnership (Grassy Narrows I.R. 21)	diamond drilling, test block removal, sample tiles produced ASTM testing[1], market evaluation
5.	Nelson Granite (Docker Township)	production mining (quarrying)
6.	Kuhner, Knut (Puddy Lake)	sample evaluation, beneficiation studies
7.	Wabigoon Resources (Zealand Township)	sample evaluation, beneficiation studies

[1] see text below for explanation

on First Nation lands. Currently, 4 locations have been investigated: 2 sites on Swan Lake I.R. 29, 1 at Islington I.R. 29, and another at Grassy Narrows I.R. 21.

On Swan Lake I.R. 29, 2 sites were tested. The first site, at Cygnet Lake (southeastern corner of the reserve), is a coarse-grained, brown granite. The second site, located north of Cygnet Lake at Beaver Lake, is a reddish-brown, fine-grained granite. The Cygnet Lake site was drilled, test blocks were removed from both sites and tested using American Society for testing and materials (ASTM) standards (Storer 1988). Tiles were produced for market evaluation. The Islington I.R. 29 site was drilled to evaluate a pink-grey to green-grey, coarse-grained granodiorite. Samples of the drill core are currently being polished. At Grassy Narrows I.R. 21, a grey, porphyritic granite was drilled. Test blocks were removed with sample tiles produced for market and ASTM testing. ASTM test results are available from the Assin Partnership. Tests conducted included: absorption and bulk specific gravity (ASTM standard test C97-83), modulus of rupture (C99-87), and compressive strength (C170-87). Sample tiles are also available for examination (I. Milligan, The Assin Partnership, personal communication, 1991).

Nelson Granite continued examining its Docker Township properties which are in close proximity to its existing quarry.

Soapstone

The New Alberene Soapstone Company of Schuyler, Virginia, began an investigation of 2 soapstone occurrences in northwestern Ontario. The Puddy Lake occurrence, held by Knut Kuhner of Thunder Bay, is hosted in a serpentinized ultramafic intrusion. The occurrence is approximately 175 km northwest of Thunder Bay and is described by Gerow et al. (1991). The Wabigoon prospect is located in Zealand Township approximately 2 km west of the town of Wabigoon. The soapstone is hosted within a gabbro body and bounded on both sides by shear zones. The prospect is also described by Gerow et al. (1991). Samples from both properties were sent to Virginia for testing and analysis. New Alberene, a subsidiary of Tulikivi of Finland, is looking for soapstone which contains minimal asbestiform-fibre minerals for use in tile production.

INDUSTRIAL MINERAL STAFF ACTIVITIES

The Industrial Minerals Program is staffed by P. Hinz, Resource Geologist and R. Lucas, Geological Assistant, under the general supervision of the Schreiber-Hemlo Resident Geologist Program.

Staff activities included monitoring industrial mineral exploration and development within northwestern Ontario, compilation of data and information related to mineral occurrences and deposits, and daily consultation with prospectors, industry, Resident Geologist's staff and the public.

In the Marathon area, the shoreline of Carden Cove, Lake Superior was mapped to investigate its potential for granite dimension stone. Findings for the Carden Cove project are given in the "Property Examinations" section.

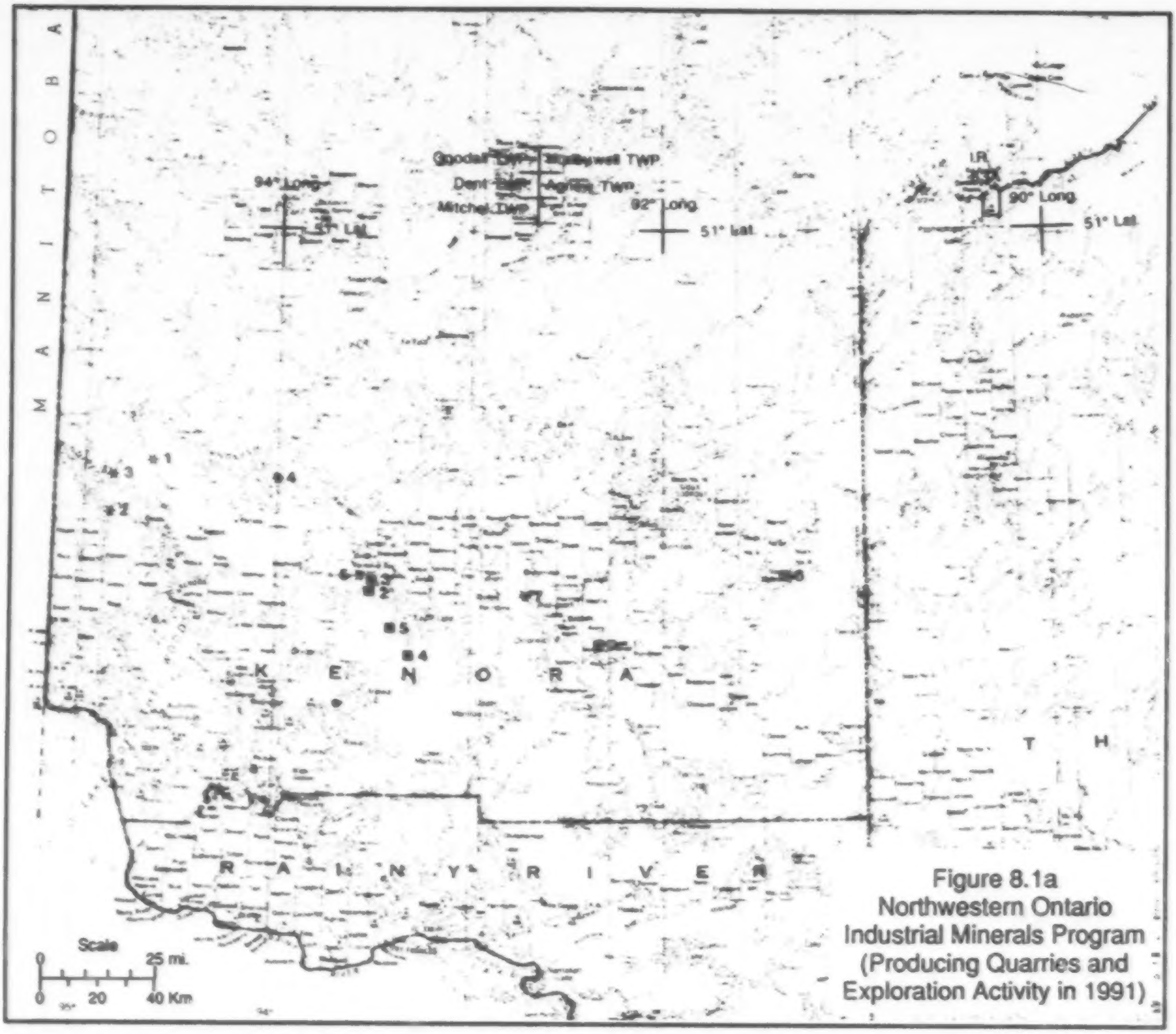
M A N I T O B A
Goodall Twp
TWP
Dent Twp
Agnew Twp
Mitchell Twp
94° Long
51° Lat
92° Long
51° lat
90° Long
51° Lat
IR
1
2
3
4
5
6
7
K E N O R A
T H
R A I N Y R I V E R
Scale
0
25 mi.
0
20
40 Km
Figure 8.1a
Northwestern Ontario
Industrial Minerals Program
(Producing Quarries and
Exploration Activity in 1991)

Figure 8.1a Northwestern Ontario Industrial Minerals Program (Producing Quarries and Exploration Activity in 1991).

EXPLANATION

■ Producing Quarries, 1991

1. A.J. Wing and Sons Construction Ltd./L.T.L. Contracting Ltd.
2. Nelson Granite Ltd.
3. Granite Quarries (G.Q.I.) Inc.
4. Crystal Quarries Ltd.
5. Thorgrimson, F.
6. C.N. Railway
7. C.P. Railway

∗ Exploration Activity in 1991 (keyed to Table 8.2)

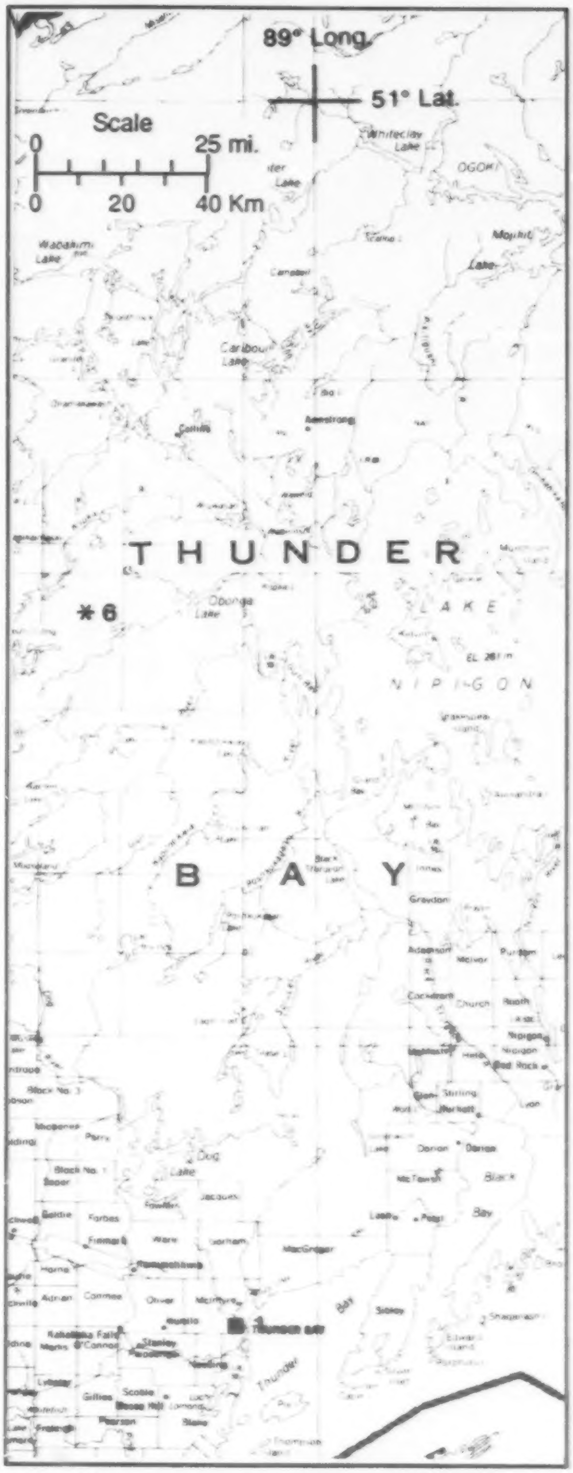
89° Long.
51° Lat.
Scale
0
25 mi.
0
20
40 Km
Whiteclay Lake
OGOKI
Mojikit Lake
Wabakimi Lake
Caribou Lake
Collins
Armstrong
THUNDER
LAKE
NIPIGON
*6
Obonga Lake
B A Y
Graydon
Nipigon
Red Rock
Dorion
Black Bay
Dog Lake
Kakabeka Falls
Thunder Bay
Sibley

Figure 8.1b Northwestern Ontario Industrial Minerals Program (Producing Quarries and Exploration Activity in 1991).

Table 8.3. Industrial mineral property examinations—1991.

1)	Treelined Lake	– graphite
2)	Granite Quarriers Inc.[2]	– pink granite
3)	Eagle Lake[2]	– soapstone
4)	Crystal Quarries Ltd.[2]	– crushed quartz
5)	Dyment quarry[2]	– railway ballast
6)	Watcomb quarry[2]	– railway ballast
7)	Northern Light Lake	– soapstone
8)	Peridotite Lake	– soapstone
9)	Poshkokagan River	– limestone
10)	Penassen Lake	– red granite
11)	Pearl Lake quarry	– red granite
12)	Dorion (F. Marier)	- sandstone, red shale
13)	Ruby Hill1	– marble
14)	Hughes Point	– marble
15)	La Grange Island	– red sandstone
16)	Vert Island	– red sandstone
17)	McKirdy Township	– limestone, kaolin
18)	Cypress Lake[1]	– radiometric survey
19)	Halonen occurrence	– fluorite, barite
20)	Pays Plat	– barite
21)	Lafontaine fluorite	– fluorite, barite
22)	Santoy Lake[1]	– radiometric survey
23)	Dead Horse Creek[1]	– rare earth elements
24)	Renshaw-Tripp	– titanium
25)	Coldwell Lake	– nepheline syenite
26)	Geordie Lake[1]	– radiometric survey
27)	Marathon occurrences	– niobium
28)	Port Munroe	– niobium
29)	Angler quarry	– black granite
30)	Peninsula quarry	– red granite
31)	Cold Spring quarry	– brown granite
32)	C.S. Downey (Shack Lake)	-- spectrolite
33)	Dotted Lake	– white granite
34)	Swill Lake[1]	– garnet
35)	LeMay Road	– pink granite
36)	Taradale Lake	– graphite
37)	Little Charon Lake	– graphite
38)	Chipman Lake	– rare earths elements, niobium

[1] visited during a field trip conducted in 1991
[2] currently producing

A total of 38 property visits, representing 18 industrial mineral commodities, was conducted in 1991 (*see* Table 8.3 and Figures 8.2a and 8.2b).

A talk on the Northwestern Ontario Industrial Minerals Program was presented at the Northwestern Ontario Mines and Minerals Symposium in April, in Thunder Bay. Presentations, dealing with prospecting for industrial minerals, were made to prospector information sessions and classes in Manitouwadge, Marathon, Terrace Bay, Nipigon and Thunder Bay.

A display, entitled "Industrial Mineral Activities in Northwestern Ontario", was presented at the Institute on Lake Superior Geology in Eau Claire, Wisconsin, in May 1991. All findings were presented in display format at the Mines and Minerals Symposium held in Toronto, December 1991, and will be presented in April, 1992, at the Northwestern Ontario Mines and Minerals Symposium in Thunder Bay. Prospector information sessions are planned to be held in Beardmore, Geraldton, Heron Bay, Kenora, Marathon, Red Lake, Sioux Lookout and Thunder Bay.

P. Hinz attended the following functions: 1) a seminar in March titled "Geophysical Solutions to Geologic Problems of Continental Interiors: A Minnesota Workshop" in Minneapolis, Minnesota, hosted by the University of Minnesota and the Minnesota Geological Survey; 2) a conference in October titled "Industrial Minerals '91, Third Annual Canadian Conference on Markets for Industrial Minerals", hosted by Blendon Information Services in Toronto; and 3) a course in November titled "The Valuation of Industrial Mineral Resources", hosted by the University of Alabama and the Alabama Geological Survey in Tuscaloosa, Alabama.

PROPERTY EXAMINATIONS

La Grange Island Sandstone Quarry

The La Grange Island sandstone quarry is located on the southeast side of La Grange Island (Figure 8.3) in Nipigon Bay, Lake Superior. The island is 13.5 km southeast of the town of Nipigon and is accessible by boat from the Nipigon marina launch site. The quarry is approximately 250 m northwest of a small bay on the east side of the island.

The author visited the former quarry site with Jack and Maureen Dampier, the current claim holders.

The quarry face is approximately 24 m wide and 7.5 m at its highest point (Figure 8.4). The sandstone present in the pit is a red quartz arenite of the Pass Lake Formation of the Mesoproterozoic Sibley Group (Kennedy and Sherlock 1989). The quarry face displays interbedded paraconglomerate, pebbly arenite and quartz arenite. Between 2 conglomeratic units, sedimentary structures such as horizontal lamination, planar bedding, cross-bedding, ripples and dish structures(?) were observed. Reduction spots (Scott 1987) were observed in the quartz arenite at its upper contact with the lower conglomerate. The quartz arenite contains beds ranging in thickness from very thinly bedded (1 to 3 cm) to medium bedded (10 to 30 cm). The fact that the beds are no thicker than 30 cm indicates that this site would not be suitable for the removal of large blocks as dimension stone. The very thinly bedded material would be suitable for use as a flagstone. The La Grange quartz arenite is similar to that at the Vert Island quarry, 1.5 km to the east, which is 80% silica (Kennedy and Sherlock 1989). Tests conducted on samples from Vert Island using the ASTM test method (C241-85), abrasion resistance of stone subjected to foot traffic, returned a value of 25. The ASTM standard specification for sandstone requires a minimum value of 8. The abrasion resistance value is a function of a sample's specific gravity, the average weight of the sample and the loss of weight during the grinding test (Storer 1988). The test results and the ability to split the stone into thin sheets would indicate the La Grange sandstone would make an excellent flagstone.

Carden Cove Syenites

As part of the continuing evaluation of the dimension stone potential of the Marathon area, industrial minerals staff mapped

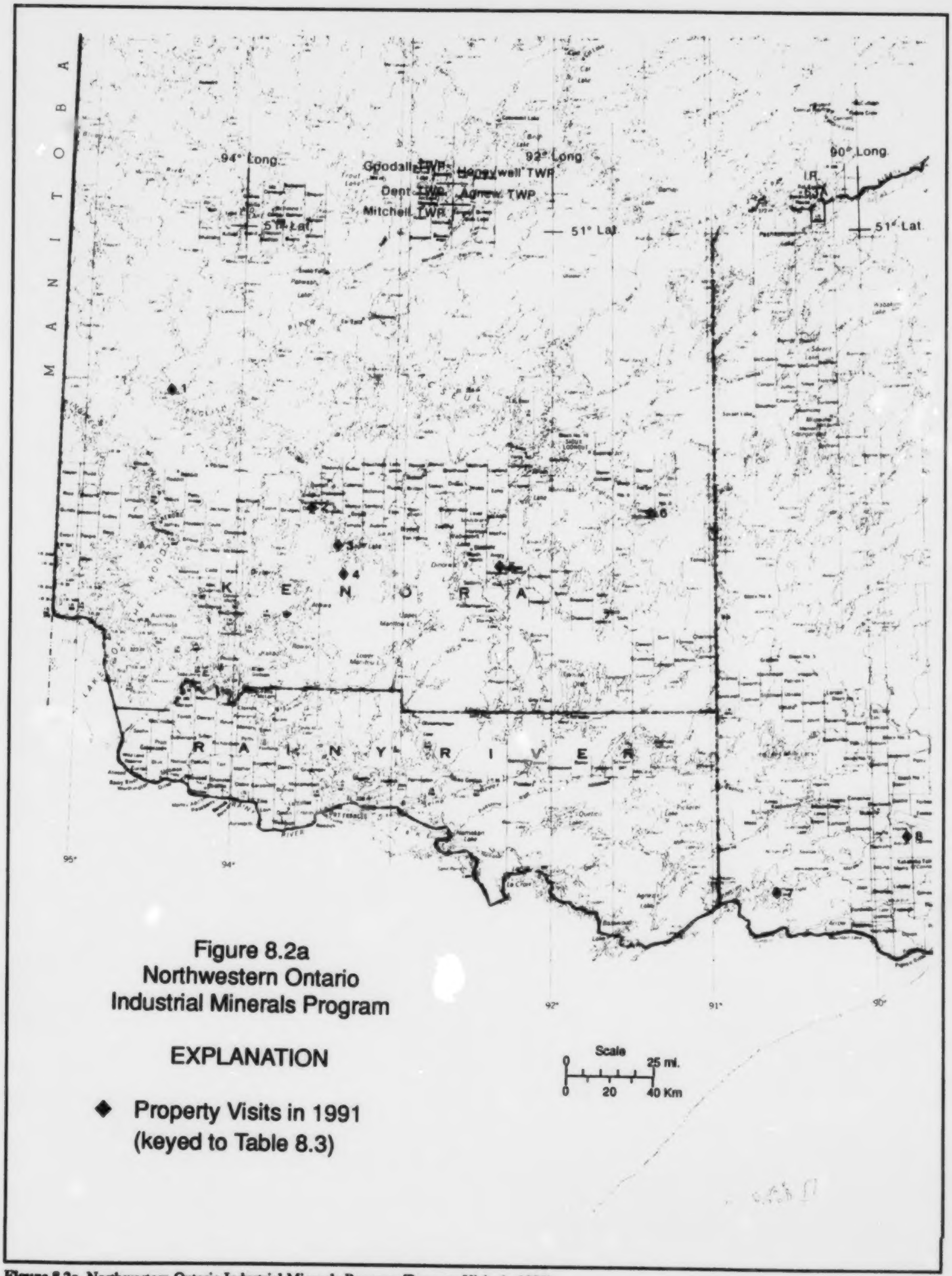
M A N I T O B A
94° Long.
Goodall TWP
Honeywell TWP
Dent TWP
Agnew TWP
Mitchell TWP
92° Long
90° Long.
I.R.
51° Lat.
51° Lat.
51° Lat.
1
2
3
4
5
6
7
8
K E N O R A
R A I N Y R I V E R
95°
94°
92°
91°
90°
Figure 8.2a
Northwestern Ontario
Industrial Minerals Program
EXPLANATION
◆ Property Visits in 1991
(keyed to Table 8.3)
Scale
0
25 mi.
0
20
40 Km

Figure 8.2a. Northwestern Ontario Industrial Minerals Program (Property Visits in 1991).

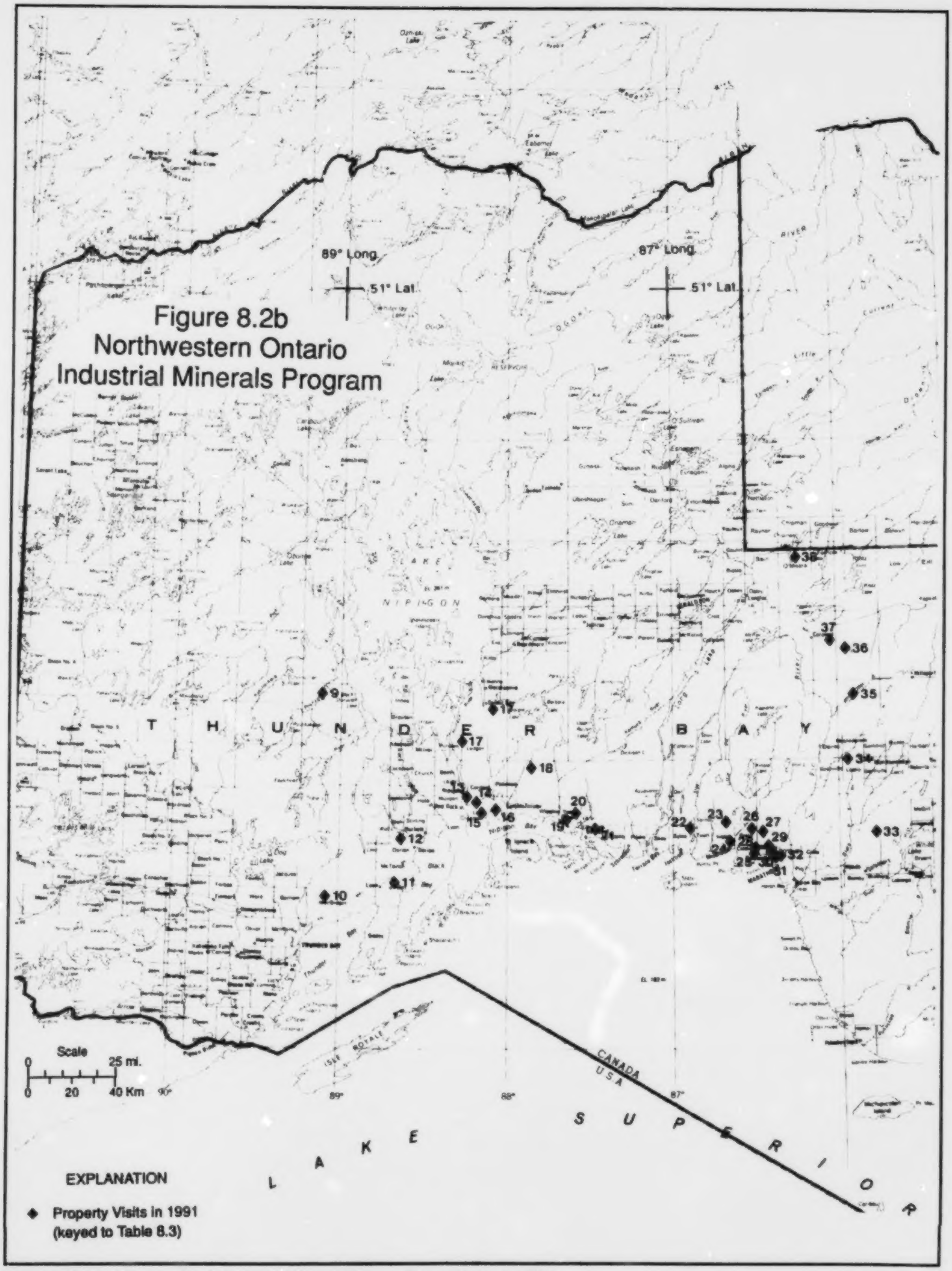
Figure 8.2b
Northwestern Ontario
Industrial Minerals Program
89° Long.
51° Lat.
87° Long.
51° Lat.
LAKE
NIPIGON
T H U N D E R B A Y
RIVER
Little
9
10
11
12
13
14
15
16
17
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
Scale
0
25 mi.
0
20
40 Km
90°
89°
88°
87°
ISLE ROYALE
CANADA
U.S.A.
LAKE SUPERIOR
EXPLANATION
◆ Property Visits in 1991
(keyed to Table 8.3)

Figure 8.2b. Northwestern Ontario Industrial Minerals Program (Property Visits in 1991).

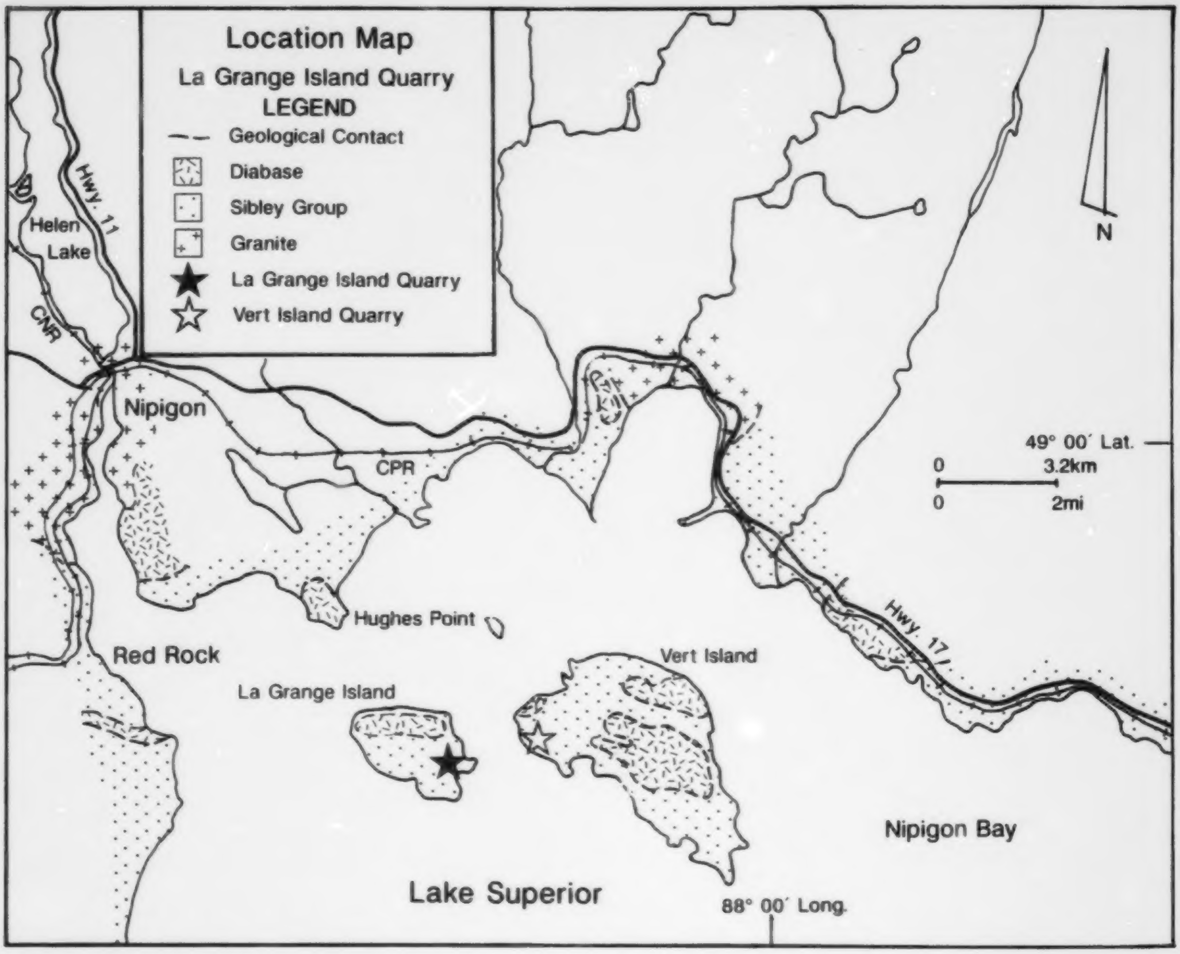
Location Map
La Grange Island Quarry
LEGEND
Geological Contact
Diabase
Sibley Group
Granite
La Grange Island Quarry
Vert Island Quarry
Helen Lake
Hwy. 11
CNR
Nipigon
CPR
Hughes Point
Red Rock
La Grange Island
Vert Island
Hwy. 17
N
49° 00′ Lat.
0
3.2km
0
2mi
Nipigon Bay
Lake Superior
88° 00′ Long.

Figure 8.3. La Grange Island Quarry location map.

the shoreline of Carden Cove, Lake Superior. The cove is immediately north of the town of Marathon (Figure 8.5) and has 4 past-producing quarries within 1 km of its shoreline.

Rock nomenclature and descriptions of Puskas (1967) have been adopted for naming the local rocks, which are part of the Mesoproterozoic Coldwell alkalic complex. The predominant rock type at the north end of the cove (Figure 8.6) is syenodiorite, while the southern portion is primarily augite syenite, historically termed "laurvikite".

The syenodiorite is massive, medium- to coarse-grained with a striking red to reddish-brown colour. Jointing frequency ranged from 10 cm to a maximum of 2 to 3 m. A shear zone, striking 160°, was noted approximately 400 m from the north end of the cove. The shear parallels the shoreline southward for approximately 100 m and veers into the lake. Thin (1 to 5 mm) magnetite veinlets were observed at numerous locations. Alteration halos (2.5 cm to 0.75 m) envelope the magnetite veinlets and were noted as lighter, "bleached" sections of syenodiorite. Near the southern contact with the augite syenite there is an abundance of pegmatitic dikes.

Further south, augite syenite occurs. The rocks vary in grain size from coarse-grained to pegmatitic with colours ranging from dark brown to black. Numerous fractures, dikelets and magnetite veinlets with random orientations are developed. Textural irregularities composed of mafic minerals were seen at numerous locations. These irregularities decrease southwards and may represent a mixing zone between the syenodiorite and augite syenite. The augite syenite has joint spacings ranging from 0.5 to 3 m.

Structural readings from shoreline and quarry mapping yield two distinct jointing directions. The primary joint direction is between 60° and 70° with the secondary direction at 0° to 10°. Sheeting (horizontal) joints in the augite syenite ranged from 8 cm to 2 m apart. Sheeting was not noted in the syenodiorite.

The highest potential area appears to be in the northern part of the mapped section. Syenodiorite seen in shoreline exposures and surrounding the Peninsula Granite Quarry are bright red, homogeneous in texture and massive.

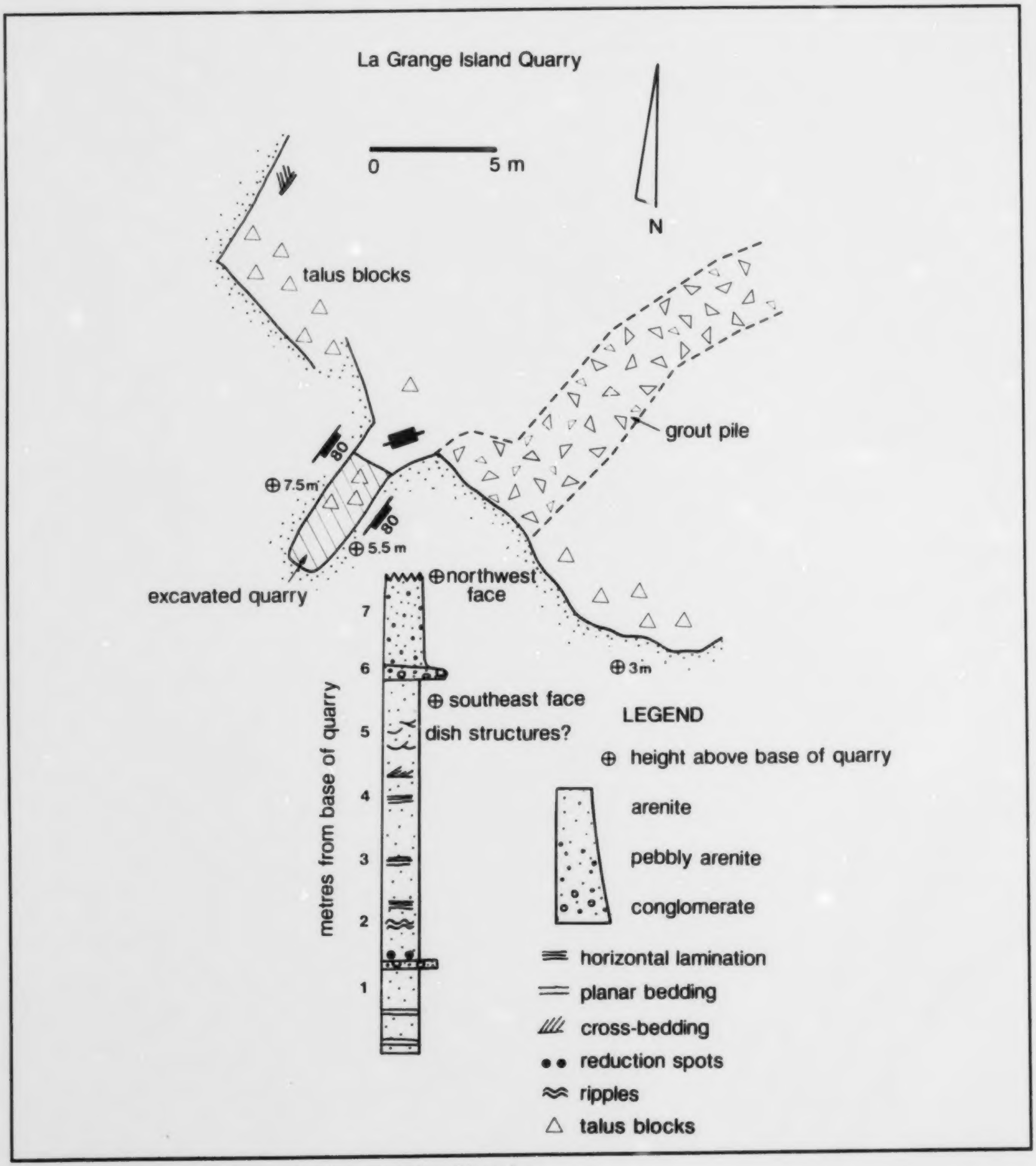
La Grange Island Quarry
0
5 m
N
talus blocks
grout pile
80
80
⊕ 7.5m
⊕ 5.5 m
excavated quarry
⊕ northwest face
⊕ 3m
⊕ southeast face
dish structures?
metres from base of quarry
1
2
3
4
5
6
7
LEGEND
⊕ height above base of quarry
arenite
pebbly arenite
conglomerate
horizontal lamination
planar bedding
cross-bedding
reduction spots
ripples
talus blocks

Figure 8.4. La Grange Island Quarry plan view and stratigraphic section.

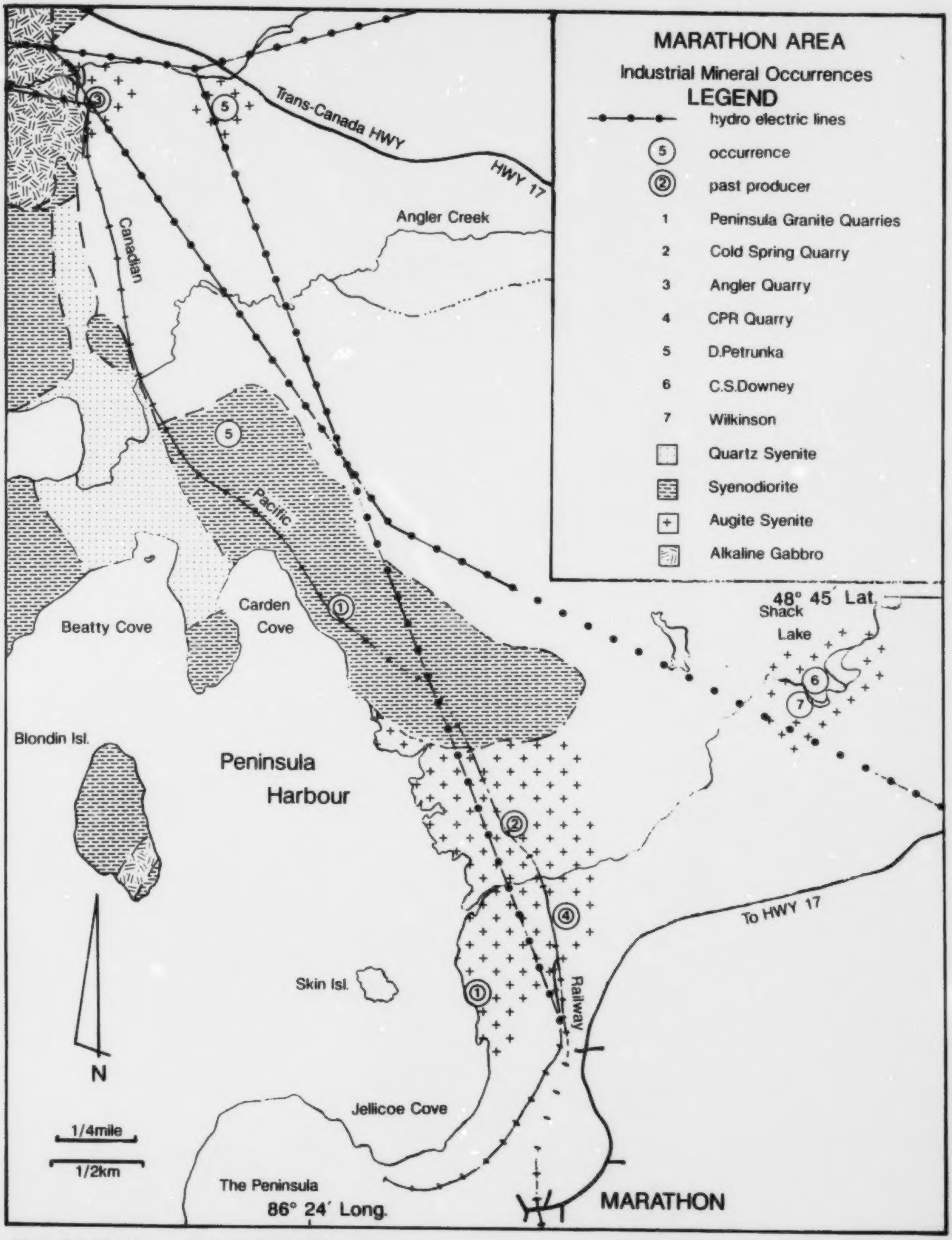
MARATHON AREA
Industrial Mineral Occurrences
LEGEND
hydro electric lines
occurrence
past producer
1 Peninsula Granite Quarries
2 Cold Spring Quarry
3 Angler Quarry
4 CPR Quarry
5 D.Petrunka
6 C.S.Downey
7 Wilkinson
Quartz Syenite
Syenodiorite
Augite Syenite
Alkaline Gabbro
Trans-Canada HWY
HWY 17
Angler Creek
Canadian
Pacific
Railway
48° 45´ Lat.
Shack Lake
Beatty Cove
Carden Cove
Blondin Isl.
Peninsula Harbour
Skin Isl.
To HWY 17
Jellicoe Cove
The Peninsula
86° 24´ Long.
MARATHON
N
1/4mile
1/2km

Figure 8.5. Marathon area industrial mineral occurrences.

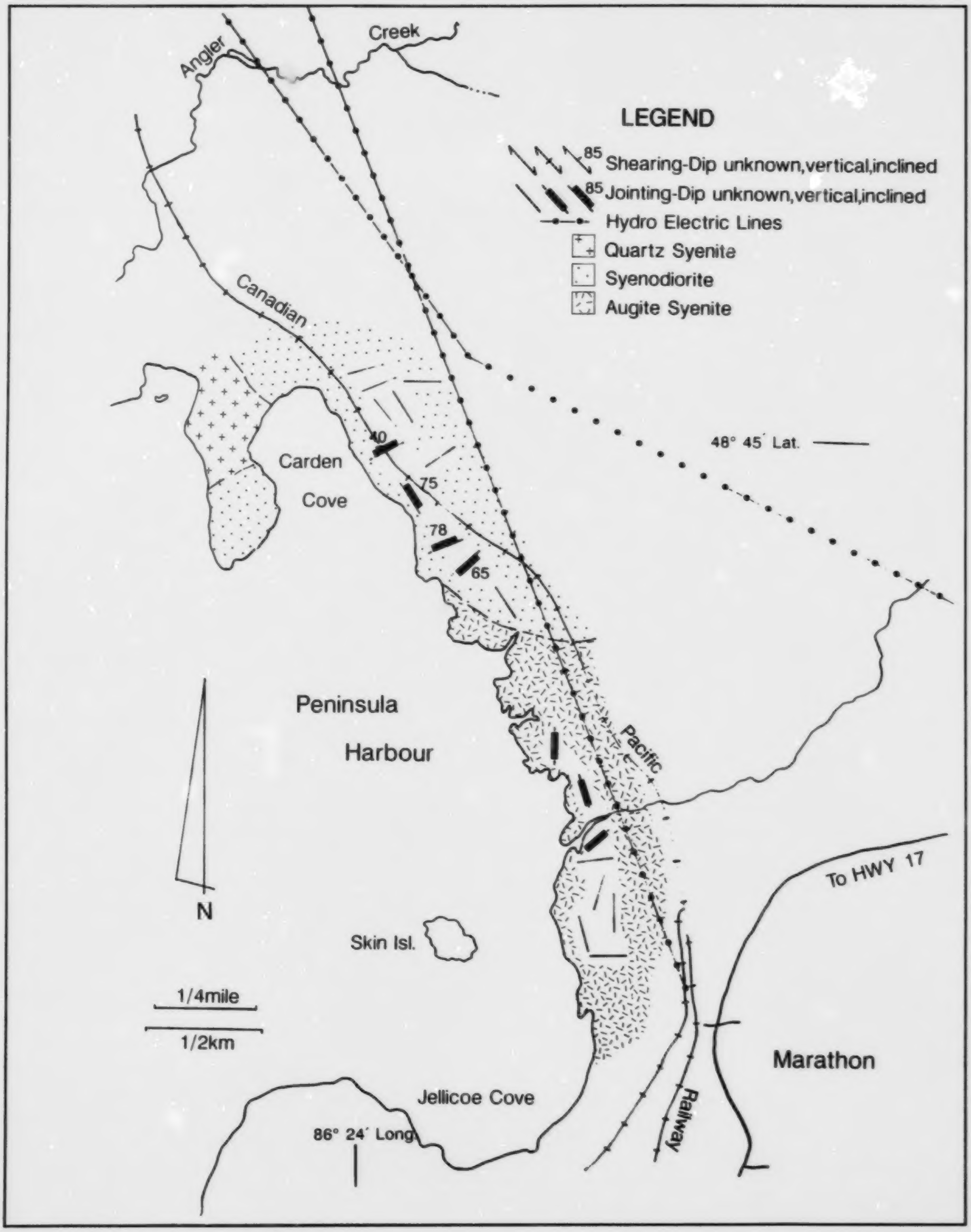
Angler
Creek
LEGEND
85 Shearing-Dip unknown,vertical,inclined
85 Jointing-Dip unknown,vertical,inclined
Hydro Electric Lines
Quartz Syenite
Syenodiorite
Augite Syenite
Canadian
Pacific
Railway
48° 45´ Lat.
40
75
78
65
Carden
Cove
Peninsula
Harbour
N
Skin Isl.
1/4mile
1/2km
To HWY 17
Marathon
Jellicoe Cove
86° 24´ Long.

Figure 8.6. Carden Cove shoreline geology.

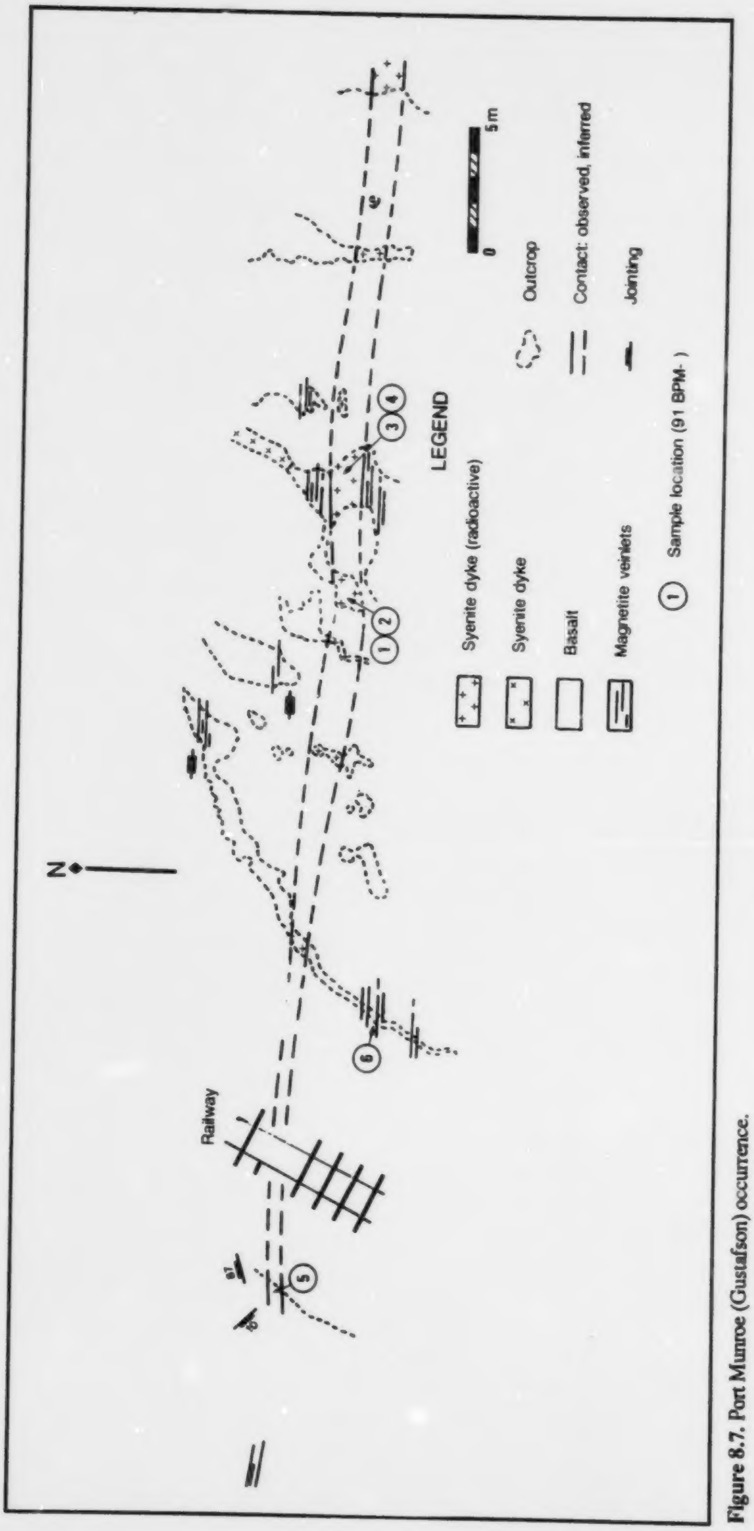
N
Railway
5
87
6
1
2
3
4
LEGEND
Syenite dyke (radioactive)
Syenite dyke
Basalt
Magnetite veinlets
Sample location (91 BPM-)
Outcrop
Contact: observed, inferred
Jointing
0
5 m

Figure 8.7. Port Munroe (Gustafson) occurrence.

Port Munroe (Gustafson) Occurrence

This occurrence is located within the Coldwell alkalic complex on the Canadian Pacific Railway approximately 8 km west of Marathon. It was discovered and explored as a columbium (i.e. niobium) property in 1949 but has received sporadic attention since then.

The local geology has been described by Lang (1952), Pye (1954), Fenwick and Scott (1978), and Scott (1987). Niobium mineralization is hosted locally by a radioactive red syenite dike that intrudes fine-grained, basaltic rocks (Figure 8.7). As noted by Pye (1954), the mineralized, steeply dipping dike strikes east and has been traced for 450 m. Near the tracks, the dike varies in width from 1 to 2 m. Whereas most of the dike consists of fine-grained, pink to red syenite, wider portions may host texturally and mineralogically dissimilar marginal phases and mineralized zones. Red to maroon colouration is developed in the altered mafic rocks, marginal to the dike contacts. Ubiquitous, thin (up to 4 mm) magnetite veinlets occur in the mafic host rocks up to several metres from the dike and are invariably oriented parallel to regularly developed joints and the dike contacts. Some breccias are developed near the dike that consist of variably altered syenite and mafic fragments in a matrix of magnetite. A small, non-radioactive syenite dike intrudes the mafic rocks to the north of the mineralized dike. On the west side of the tracks, a rusty, pyritiferous zone occurs along strike with the main dike.

Mineralized sections up to 15 cm wide consist of coarse-grained (up to 12 cm) amphibole and feldspar crystals, with variable amounts of purple fluorite, calcite, magnetite and a euhedral mineral, tentatively identified as garnet or perhaps pyrochlore. Fenwick and Scott (1978) reported that andradite garnet, calcite, feldspar, limonite and sphalerite were identified. Disseminated chalcopyrite and pyrite were noted in the mafic host rocks east along the tracks.

Thin section petrography of recently collected samples is still ongoing. Preliminary investigation has reaffirmed the presence of abundant calcite and zoned euhedral fluorite and garnet. Electron microprobe analyses will be undertaken to identify the problematic mineralogy and geochemical variations therein. McLaughlin and Mitchell (1989) have identified fluorocarbonates and primary niobium-bearing phases, columbite and niobian zirconolite, in similarly mineralized rocks within the Coldwell complex.

Grab samples analysed by Pye (1954) returned up to 1.35% Nb_2O_5, 0.08% U_3O_8, 3.00% ThO_2 and 12% Ce. Chip samples taken by T. Gustafson in 1961 ranged from 1.13% Nb_2O_5 over 0.9 m to 1.56% Nb_2O_5 over 1.2 m (Resident Geologist's files, Schreiber-Hemlo District, Thunder Bay). Two grab samples collected by Fenwick and Scott (1978) assayed 0.42 and 1.0 pound U_3O_8, 0.92% and 1.27% Nb_2O_5, and 0.45% and 0.5% Ce, respectively. The first sample also returned 0.45% Zn. Grab samples collected by P. Moses, a prospector from Marathon, in 1987 and 1988 returned the following assays:

Sample No.	Be	U	Ce	Nb	Y	Zr	Th	P_2O_5
87 BPM–01	17	9500	1.1%	1.5%	1400	2.0%	3.8%	0.24%
–02	40	7500	3300	0.9%	390	1.9%	3.0%	0.08%
–03	50	6200	4200	0.9%	520	1.9%	2.8%	0.14%
–04	<1	7	215	133	43	338	22	0.24%
88 BPM–04	17	0.56	18	—	5.1	—	—	n.a.

(n.b.: all analyses in ppm unless otherwise stated)
(Resident Geologist's Files, Schreiber-Hemlo District, Thunder Bay)

Sample Descriptions:

87 BPM–01:	radioactive, maroon to black, altered mafic host(?), with calcite and garnet(?)
–02:	radioactive, maroon to black, altered mafic host(?), with calcite, garnet(?) and feldspar
–03:	radioactive, fine-grained, maroon-altered mafic host(?), with calcite
–04:	moderately radioactive, fine-grained, pink-red syenite, with minor malachite staining
88 BPM–04:	massive (<85%) magnetite with veinlets of a yellow-brown, resinous mineral, calcite and epidote; non-radioactive

Analyses from 1991 sampling are still pending.

Chondrite-normalized rare earth element (REE) plots show that niobium-uranium-thorium-mineralized samples show marked enrichment in light REE, a moderate negative europium anomaly and a relatively flat heavy REE pattern. This pattern is somewhat similar to those from carbonate-rich diatreme breccias in the Dead Horse Creek area, but is very dissimilar to those from beryllium- and zirconium-rich, niobium-poor samples at the same locality (Smyk et al. 1989; Schnieders and Smyk 1989).

The metallogenesis of niobium-bearing, uranium- and thorium-rich syenites has been addressed most recently by McLaughlin (1990). It will be further studied as part of the Coldwell complex project being currently undertaken by staff and students at the University of Western Ontario and funded by the Ontario Geoscience Research Grant Program, in conjunction with staff of the Schreiber-Hemlo Resident Geologist's Office and the Northwestern Ontario Industrial Mineral program.

Lafontaine Fluorite Occurrence

The Lafontaine fluorite occurrence is located approximately 13 km west of the town of Schreiber and 2 km north of Highway 17. The vein occurs at the base of a cliff within a prominent north-trending fault. The occurrence was initially held by A. Douglas and drilled by Jorex Ltd. in 1973. In 1977, A. Lafontaine staked the property and contacted Hanna Mining Company to option it (Assessment Files, Schreiber–Hemlo District, Thunder Bay).

The vein appears to be composite in nature; it is 0.4 m wide and hosted in a pink porphyritic granite. The vein system, which strikes 352° and dips 76° west, contains purple fluorite, quartz, barite and amethyst. Fluorite occurs as euhedral cubes and amorphous vein-fillings. Barite pods up to 10 cm wide are present with quartz rims. Within the vein breccia, granitic fragments are strongly epidotized.

Taradale Lake Graphite Occurrence

This occurrence is located approximately 39 km north of the town of Manitouwadge, 6.5 km east of the Stevens siding, on the Canadian National Railway line.

Located within the Neoarchean Quetico Subprovince, the graphite schist outcrops for 75 m on the north side of a railway rock cut. The schist ranges in width from 0.5 to 3 m and is hosted by sheared migmatitic rocks striking at 95° and dipping 84° south. Graphite is present as medium- to coarse-grained flakes which are aligned parallel to the foliation. Seams from 1 to 2 cm in width contain up to 25% flake graphite. The presence of fine-grained pyrite and chalcopyrite produce a rusty weathered surface. Numerous quartz-feldspar-biotite pegmatite dikes crosscut the schist. Biotite is abundant within the host rock, schist and pegmatites.

RECOMMENDATIONS FOR EXPLORATION

Dimension Stone

The dimension stone market in Canada continued to grow during 1991 (Zielinski 1991). Producers utilized advanced technologies related to quarrying, fabrication and installation to improve production. With the elimination of tariffs on square, rectangular and slab granite (Vagt and Bergeron 1991), many producers expanded into the large U.S. market. Black, red, pink and white continue to be the colours which are in highest demand by the consumer markets. However, green, yellow and blue are filling a portion of the market. This indicates that virtually any colour with an attractive or unique texture could be marketable.

A number of granitic bodies in northwestern Ontario should be examined for their dimension stone potential. Of particular interest are two locations: the Penassen Lakes stock and the Dotted Lake batholith. The Penassen Lakes stock is located approximately 11.5 km northwest of Thunder Bay in MacGregor Township. The stock's core phase is a bright red porphyritic granite and is described by Scott (1990). The Dotted Lake batholith is located 31 km south of the town of Marathon. The stone is a massive, coarse-grained, pink biotite leucogranodiorite and is described by Schnieders et al. (1991).

Deterioration of historical buildings constructed of sandstone is creating a demand for renovation material. The sandstones of the Sibley Group should be evaluated to determine their potential and marketability. Logistical and environmental difficulties related to developing offshore deposits may tend to restrict exploration to onshore areas.

When evaluating dimension stone sites, the following criteria (Storey 1986) should be considered: fracture and jointing frequency, colour and texture, marketability of colour and texture, deleterious minerals, and size of the deposit.

Graphite

The outlook for the Canadian graphite market is good and growth should continue (Boucher 1991). Graphite is a product of metamorphism and is found worldwide in a range of schists, gneisses and marbles. Graphite used in industrial processes is grouped into three types: crystalline (flake), lump, and amorphous. Flake graphite which can be upgraded to +90% carbon is in high demand and commands prices ranging from $400 to $1200 US per metric tonne (*Industrial Minerals*, November 1991, p.77.).

Areas in northwestern Ontario which should be examined for graphite potential are the Quetico and English River subprovinces. Both subprovinces are high-temperature metamorphic terranes ranging from upper amphibolite to granulite facies. Ductile shear zones in the subprovinces should be investigated for the development of flake graphite. Prospecting and outcrop examination is most effective in evaluating graphite occurrences.

Aluminosilicates

Market trends for the aluminosilicate minerals have remained constant over 1991 (Whiteley 1991). Aluminosilicates are known to the industrial minerals industry as the sillimanite group of minerals. They are anhydrous aluminum silicate polymorphs and include the minerals sillimanite, kyanite and andalusite. Primary uses are in the refractory industry in the form of refractory bricks and for advanced ceramic applications. Harben and Bates (1984) provide information on industry specifications necessary when evaluating occurrences.

Known occurrences in northwestern Ontario are found at the following locations: in the Manitouwadge synform, near the Kamuck River located 60 km north of Terrace Bay (Schnieders et al. 1991), and in the vicinity of the South Bay mine near Ear Falls. These areas and metamorphic envelopes surrounding base metal occurrences should be investigated for their potential.

Other Commodities

More than 50 industrial mineral commodities are known to occur in northwestern Ontario. Resident Geologist offices located throughout the province contain files and references on many of the known occurrences. Prospectors are encouraged to contact their local Resident Geologist to obtain the pertinent information.

Other commodities in northwestern Ontario which merit study include brick-red shale for landscaping stone, quartz, marble, and red and black granites for agglomerate tiles.

The continued construction of golf courses in southern Ontario has increased the demand for landscaping stone used in golf cart paths. The brick-red shales of the upper Rossport Formation of the Sibley Group could provide an attractive product for this market. An examination of the shale and markets would be warranted.

Linked to the strong dimension stone market, man-made stone products produced from crushed quartz, marble and dark-coloured granites are experiencing an increased demand. Occurrences of bull-white quartz and white marbles should be examined. Preferably, occurrences of quartz devoid of any sulphides or deleterious minerals are desirable. Similarly, pure white marbles with as little dark-coloured impurities could be usable. The red and black granites should contain consistent grain size and colour. In light of the markets, the occurrences of these rocks and minerals warrant investigation.

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9. Amethyst in Northwestern Ontario—1991

M.I. Garland

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INTRODUCTION

Amethyst has been known to be in the Thunder Bay area since the mid-1600s (Patterson 1985) and has been exploited as both a marketable commodity and a tourist extraction since the 1960s. Several studies on the geology of specific occurrences have been undertaken by staff of the Thunder Bay Resident Geologist's office, and this work, plus new information on exploration targets, needs to be published. This project has a specific mandate to map all existing amethyst deposits, to analyze their regional geological controls, and to develop prospecting guides for the exploration industry. Funding for the project is provided by the 1990–1991 Employment Equity Fund and the Ontario Ministry of Northern Development and Mines' Client Services Branch.

MINING ACTIVITY

There are 8 quarry operations in the Thunder Bay Resident Geologist's District and 2 in the Schreiber–Hemlo Resident Geologist's District. Five of the 10 quarries operate as tourist attractions as well as amethyst producers, while the remaining 5 produce amethyst to fill specific-market demands. The producing quarries are shown on Figures 9.1a and 9.1b, and production from these quarries is tabulated in Tables 9.1a and 9.1b.

The 8 quarries in the Thunder Bay Resident Geologist's District are situated in McTavish and MacGregor townships. Blue Star Resources, Hietapakka–Siltimaki and the Grieves quarries extract for their own use and do not operate tourist attractions. The Ontario Gem Company, Pearl Lake, and Thunder Bay Amethyst Mine Panorama Blue Points, and the Diamond Willow mines have rock shops at the mine and allow tourists to rockhound on the premises. The proprietors of the Pearl Lake and Thunder Bay Panorama mines operate gift shops in Thunder Bay as well.

The Blue Points amethyst mine, north of the community of Pearl, produced 25 tons of amethyst and amethystine rock during the 1991 operating season. The 2 products were decorative stone, which includes landscape, fireplace and slabbing material, and excellent-quality, dark-purple mineral specimens. The mine was operational from May to October, employing 3 people at the height of the tourist season.

The Diamond Willow amethyst mine is situated on the same amethyst vein system as is the Blue Points mine and, in fact, the 2 mines are less than a kilometre apart. The Diamond Willow mine has produced similar stone in similar amounts to that produced by the Blue Points mine. Products were decorative stone and lapidary stone, as well as fine-quality amethyst specimens. Three employees worked at the Diamond Willow mine.

The Ontario Gem Company amethyst mine is located on the old Dorion Mine Road. Production this year was 26 tons and this was used to produce bookends, clocks, lapidary stone and mineral specimens. Minor amounts of breccia were quarried for landscape stone, but this was not a major product. This mine is the only known location of stromatolite structures preserved in Proterozoic sediments unconformably deposited on Archean granite. The amethyst mineralization has occurred within the stromatolitic layers giving rise to some very unusual specimens.

The Pearl Lake amethyst mine, north of Pearl, produced 70 tons of amethyst material. The main product consists of decorative and lapidary stone, including stone for giftware, and excellent samples of large amethyst druse and crystal clusters. Colour of the mineral specimens is either very dark or light purple. Specimens which are pale in colour can be quite valuable, especially if the colour darkens towards the points, thus, creating a shadow effect in the crystal. Unusual crystal specimens found in this mine are created by light-purple amethyst crystallizing on top of well-formed blades of barite. The mine employed 7 people in 1991.

The Thunder Bay Amethyst Mine Panorama produced 2500 tons of material, including 500 carats of faceting-grade amethyst. The main product is stone for jewelry and giftware and for dark-purple amethyst specimens. Decorative and landscape stone is produced and stockpiled. The store in Thunder Bay is open all year whereas the store at the mine site including the mine itself operate seasonally. Eleven people are employed during the peak tourist months. Tumbling and landscape-grade stone is stockpiled off the mine site for easier access during the winter, and this allows the Thunder Bay mine to maintain supply to customers on a year-round basis.

Blue Star Resources Limited is now producing amethyst under an aggregate permit in the unsurveyed territory north of MacGregor Township referred to on mining plan G-672 as the North of MacGregor area. The quarry began production in the late fall of 1991, and quarrying will continue as long as the Magone Lake Road is open. Amethyst specimens are packed in barrels on site and removed to the company warehouse in Thunder Bay where the amethyst is used in the manufacture of giftware.

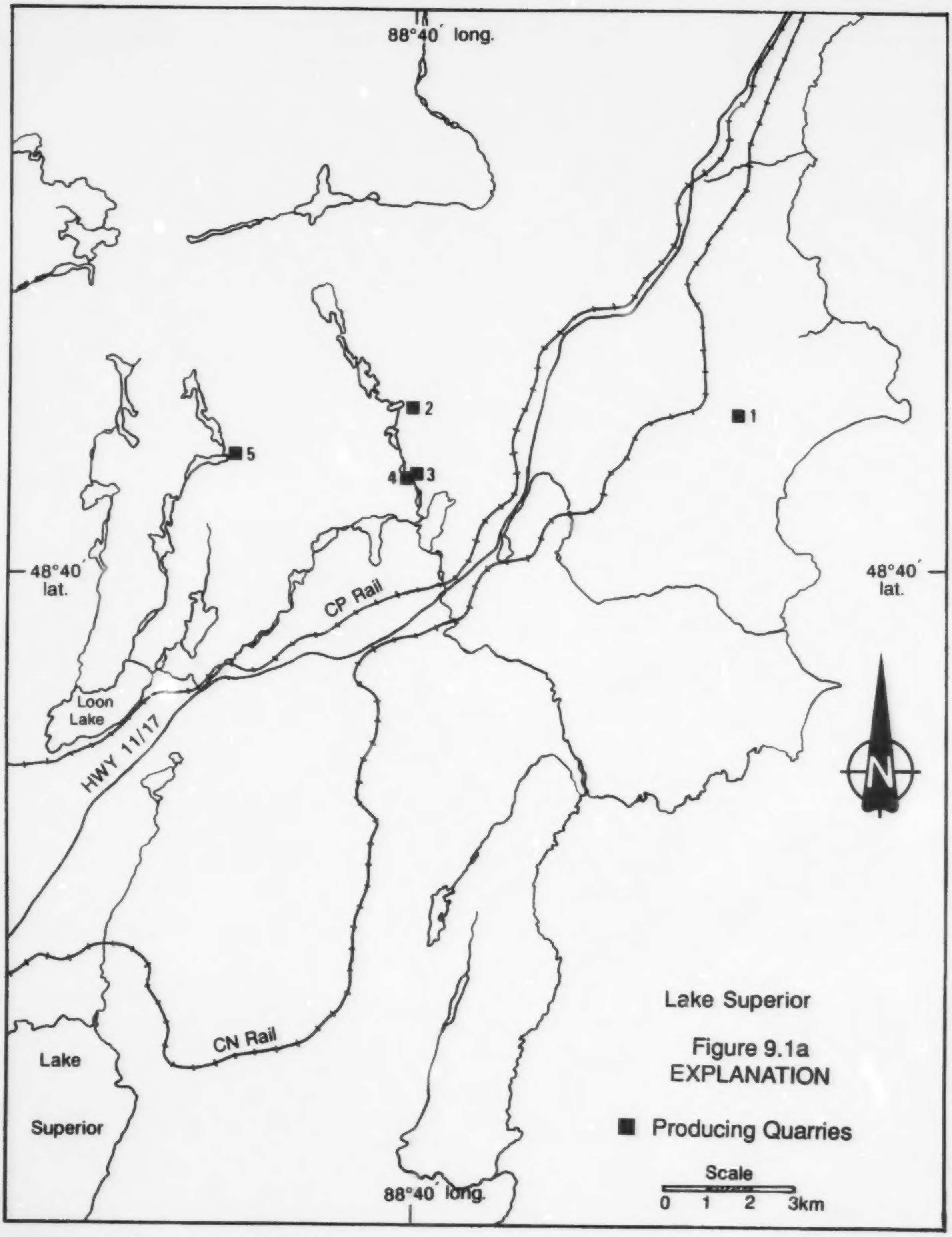
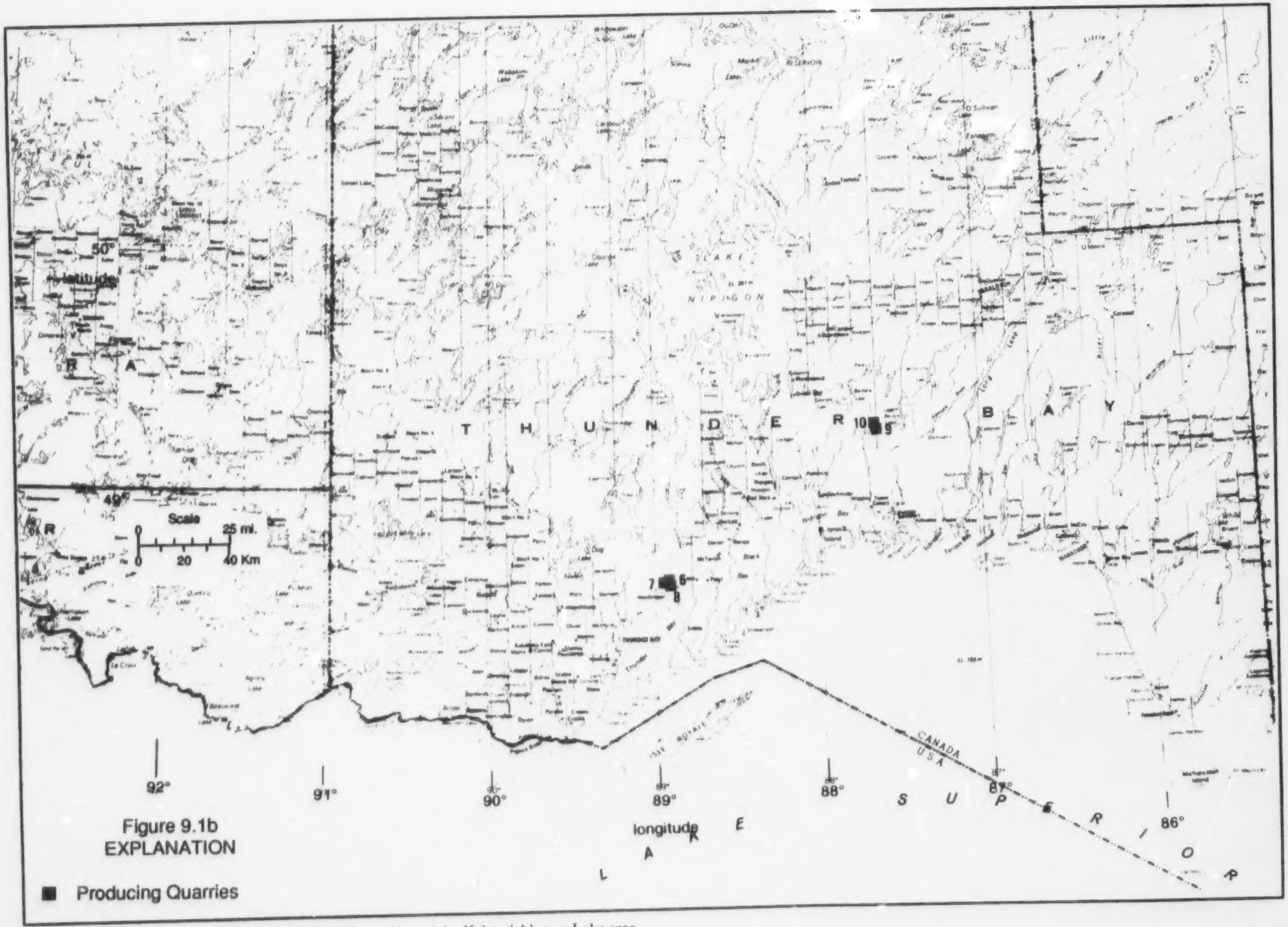

88°40´ long.
2
1
5
4
3
48°40´ lat.
48°40´ lat.
CP Rail
Loon Lake
HWY 11/17
N
Lake Superior
Figure 9.1a
EXPLANATION
■ Producing Quarries
Scale
0 1 2 3km
CN Rail
Lake Superior
88°40´ long.

Figure 9.1a. Amethyst producers in McTavish Township.


T H U N D E R B A Y
R A
LAKE NIPIGON
L A K E S U P E R I O R
CANADA
U S A
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latitude
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91°
90°
89°
88°
87°
86°
longitude
Scale
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0 20 40 Km
10
9
7
6
8
Figure 9.1b
EXPLANATION
■ Producing Quarries

Figure 9.1b. Amethyst producers in MacGregor Township and the Kabamichigama Lake area.

R. Hietapakka and A. Siltimaki removed several tons of amethyst rock from their quarry in the North of MacGregor area.

M. Grieves removed amethyst specimens from a patented claim in the North of MacGregor area for display and sale at mineral shows.

In the Schreiber–Hemlo Resident Geologist's District, there are 2 small amethyst-quarrying operations, both of which are in the same vicinity near Kabamichigama Lake. They are too far from Highway 17 to be run as tourist operations, and they produced little, if any, amethyst this year.

Table 9.1a. Amethyst producers—1991.
(Note: Numbers correlate to those of Figures 9.1a and 9.1b)

Mine	Location	Product/Production
1. Ontario Gem Company	McTavish Township	mineral specimens bookends, lapidary some jewelry 26 tons
2. Pearl Lake Amethyst Mine	McTavish Township	decorative stone specimens lapidary stone some jewelry 70 tons
3. Blue Points Amethyst Mine	McTavish Township	specimens decorative and landscape stone 25 tons
4. Diamond Willow Amethyst Mine	McTavish Township	specimens decorative and landscape stone 25 tons
5. Thunder Bay Amethyst Mine Panorama	McTavish Township	specimens lapidary and tumbling decorative stone giftware, jewelry, cut stones, beads 2500 tons, 500 carats

Table 9.1b. Amethyst producers—1991.
(Note: Numbers correlate to those of Figures 9.1b)

Mine	Location	Product/Production
6. Blue Star Resources	N. of MacGregor area	giftware
7. Hietapakka/ Siltimaki	N. of MacGregor area	building stone
8. M. Grieves	N. of MacGregor area	specimens
9. Little Bear Quarry	Kabamichigama Lake	specimens
10. Little Bear Mine	Kabamichigama Lake	specimens

ADVANCED EXPLORATION ACTIVITY AND DEVELOPMENT

North of MacGregor Area

The Gem Mountain occurrence is located on mining lease TB 974954. Amethyst veins and vugs occur on both the northwest and southeast sides of a granite ridge, approximately 1 km long and 200 m wide. Pits have been opened on both sides of this ridge, and material is ready to be removed from the northwest pits, pending the final development of the access road from the Magone Lake Road. Completion of the access road is slated for the spring of 1992. Removal of amethyst from the Gem Mountain quarry should be in full swing for the 1992 summer season.

EXPLORATION ACTIVITY

Exploration activity for amethyst was concentrated in 3 areas: McTavish Township, Jean Township and both MacGregor Township and the area to its north. This work is summarized in Tables 9.2a, 9.2b and 9.2c. The sites are indicated on Figures 9.2a, 9.2b and 9.2c. Apart from one of the established mines, most of the work was done by individual prospectors.

McTavish Township

The Pearl Lake amethyst mine continued exploration on the claim group to the west of the mine. A bush road was built to access the claims with equipment required for drilling, blasting and stripping. Two areas were cleaned to reveal a wide breccia zone and veins of light-purple amethyst.

T. Twomey continued stripping various showings on his claims in the Pearl Lake area of McTavish Township. Plans are in process for further development.

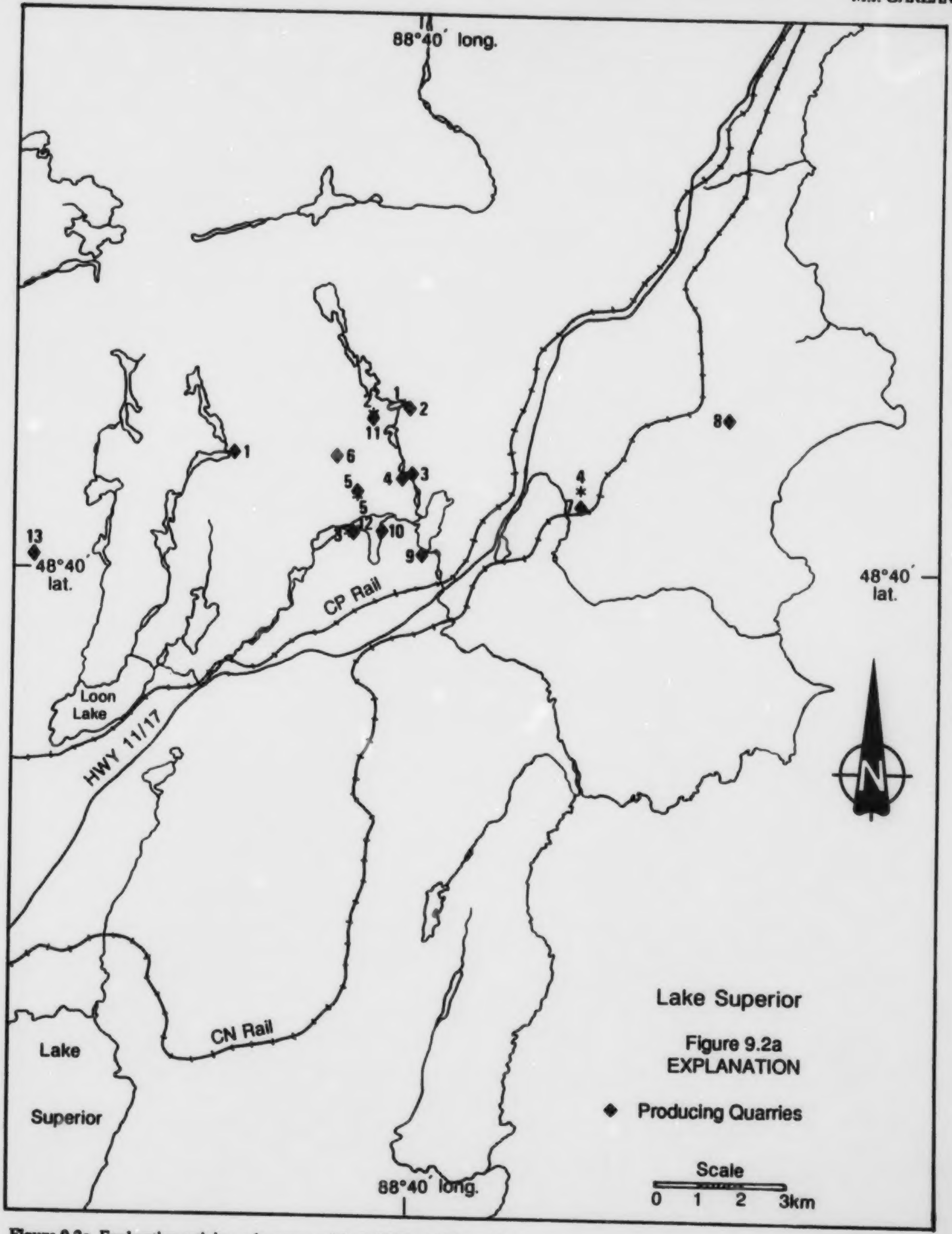
D. Bak stripped and trenched 2 showings near Sward Lake. Here, amethyst druse lines fractures in Sibley Group mudstones and fills vugs in Archean granite. One half ton of amethyst samples has been removed via an aggregate permit on one of the showings.

K. Kukkee stripped an area between the 2 shafts at the old Enterprise Mine near Pearl. He is in the process of having some of the amethyst samples appraised for faceting possibilities.

C. Noyes performed limited stripping and blasting in the vicinity of the old Detroit-Algoma lead-zinc mine.

MacGregor Township, North of MacGregor Area, and Tartan Lake Area

Apart from the known amethyst occurrences along the shoreline of Lake Superior, exploration for amethyst in MacGregor Township is opening up new areas previously unknown for any


88°40´ long.
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48°40´ lat.
48°40´ lat.
CP Rail
Loon Lake
HWY 11/17
N
CN Rail
Lake Superior
Lake Superior
Figure 9.2a EXPLANATION
◆ Producing Quarries
Scale
0 1 2 3km
88°40´ long.

Figure 9.2a. Exploration activity and property visits in McTavish Township.

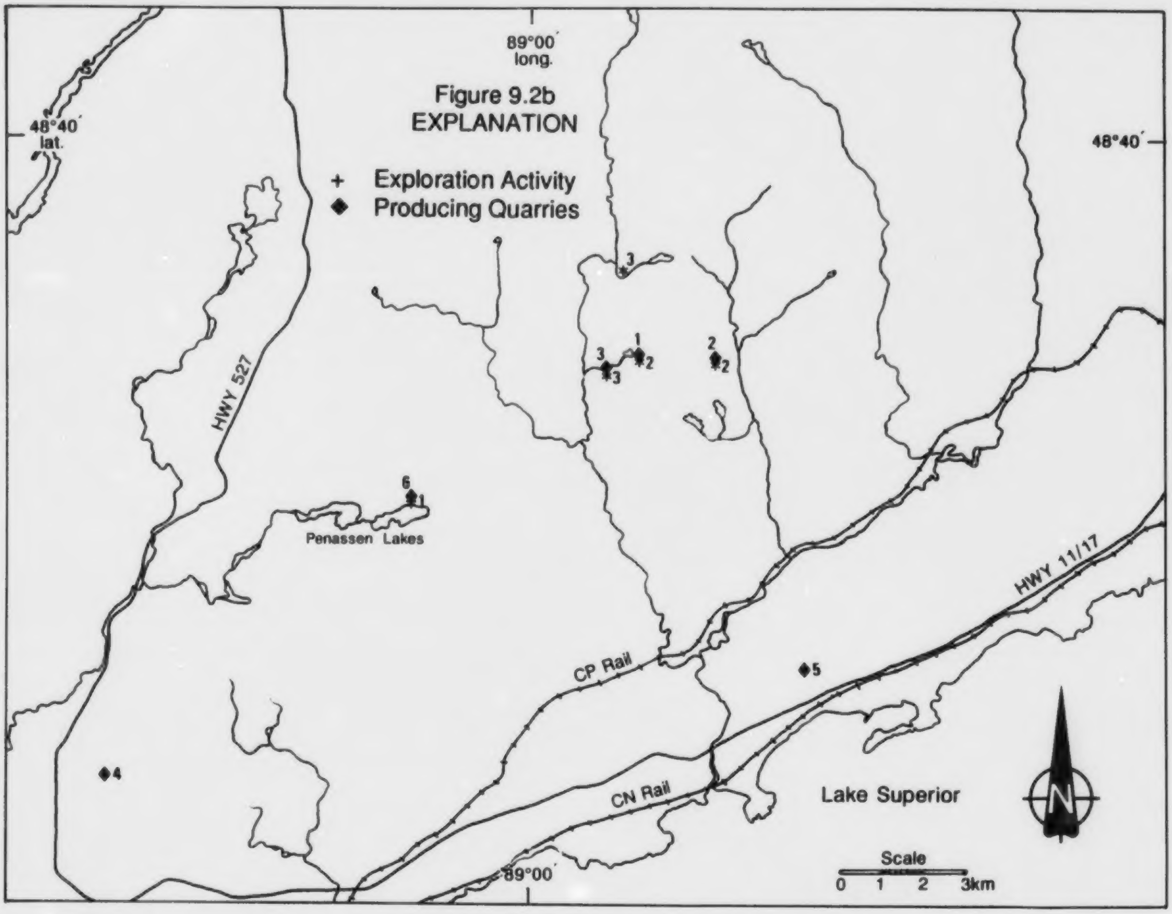


Figure 9.2b. Exploration activity and property visits in MacGregor Township and North of MacGregor Area.

amethyst potential. J. Scott, Staff Geologist for the Thunder Bay Resident Geologist's District, noted several occurrences of amethyst and quartz veining hosted in Archean granite in MacGregor Township and the North of MacGregor area. R. and O. Harty also noted and staked claims over amethyst showings in this area, which is their Gem Mountain occurrence. T. Twomey stripped several acres on his claims in the western part of MacGregor Township. G. McLeod was actively opening up amethyst veins on his claim near the Penassen Lakes in MacGregor Township. R. Hietapakka and A. Siltimaki staked and prospected several claims in the North of MacGregor and Tartan Lake areas. Subsequent stripping has exposed several amethyst veins and vugs in both areas, and production is planned when markets are established.

Jean Township

R. Hietapakka, A. Siltimaki and G. Duffey have claims in the centre of Jean Township. The amethyst is well banded and occurs in veins with white and rusty quartz. This location is also known as the site of a silver occurrence (Tanton 1931), but the old workings have not been located as yet.

REGIONAL MINERAL SPECIALIST'S ACTIVITIES

The position of Regional Mineral Specialist for northwestern Ontario was filled in April of 1991 by M. Garland. The position was a secondment to do research on amethyst in the Thunder Bay area. This required familiarization with all previous work on amethyst, visits to known occurrences and operating mines, familiarization with local and regional geology, and consultation with prospectors and interested public on amethyst.

Thirty-five property visits were conducted during the 1991 field season. The locations of these are shown on Figures 9.2a, 9.2b and 9.2c which correspond to Tables 9.3a, 9.3b and 9.3c. Most of the visits resulted in the generating of a detailed map or diagram of the occurrence. Reconnaissance mapping was done over part of the area of interest in the North of MacGregor area.

A display on Amethyst in the Thunder Bay Resident Geologist's District was presented at the Thunder Bay Mineral Show. Input was supplied to the Lapidary club at their weekly

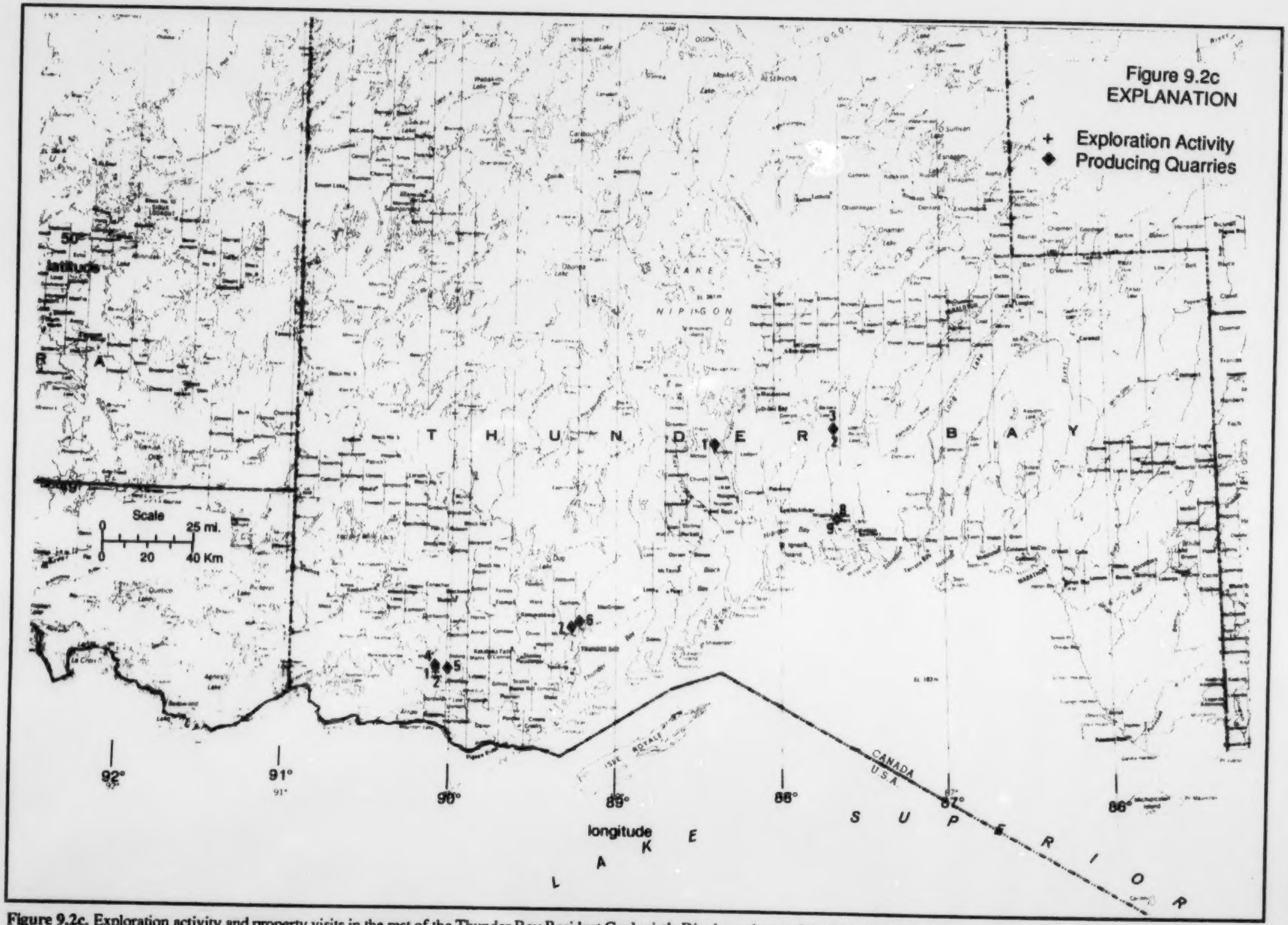


Figure 9.2c
EXPLANATION
+ Exploration Activity
◆ Producing Quarries
THUNDER BAY
LAKE NIPIGON
Scale
0
20
40 Km
25 mi.
50°
latitude
92°
91°
90°
89°
88°
87°
86°
longitude
CANADA
U.S.A.
ISLE ROYALE
LAKE SUPERIOR
1
2
3
4
5
6
7
8
9

Figure 9.2c. Exploration activity and property visits in the rest of the Thunder Bay Resident Geologist's District and part of the Schreiber–Hemlo Resident Geologist's District.

workshop sessions. Amethyst was supplied to the Ontario Government for the United Way campaign. Recommendations were presented to the author of the new brochure on Ontario's amethyst. A discussion on minerals was presented at the Prospector's Course given in Thunder Bay, and at one of the local high schools. M. Garland is part of the Public Education Committee for Northwest Ontario. A section on amethyst in Thunder Bay was written for the Ontario Geological Survey's (OGS) Special Volume 4, Part 2—*Geology of Ontario* (Garland, in press).

Table 9.2a. Exploration activity—1991.

Number on Figure 9.2a	Individual/ Company	Activity
1.	Pearl Lake Amethyst Mine	road building drilling, blasting, stripping
2.	Twomey, T.	stripping
3.	Bak, D.	stripping trenching
4.	Kukkee, K.	stripping samples tested for jewelry
5.	Noyes, C.	stripping blasting

Table 9.2b. Exploration activity—1991.

Number on Figure 9.2b	Individual/ Company	Activity
1.	McLeod, G.	blasting
2.	Harty, R.	stripping blasting
3.	Hietapakka, R. Siltimaki, A.	stripping

Table 9.2c. Exploration activity—1991.

Number on Figure 9.2c	Individual/ Company	Activity
1.	Hietapakka, R. Siltimaki, A.	prospecting digging
2.	Duffy, G.	prospecting digging

M. Garland attended the Industrial Mineral Forum in Toronto, a MICA Leadership Challenge workshop and a Leadership Skills for Women workshop in Thunder Bay.

PROPERTY EXAMINATIONS

Ontario Gem Company Amethyst Mine

The Ontario Gem Company amethyst mine is located in McTavish Township, Concession IV, lots 10 and 12. The mine is accessed via the Dorion Mine Road, approximately 4 km from Highway 17. There are several other amethyst occurrences in the vicinity, some of which are past producers for lead-zinc and amethyst.

The original leased claim was developed by Rickaby Mines Ltd. and sold successively to different people before the present owner, P. Marino, took possession in 1982. There are 3 major areas for extraction, one of which is open to the public. Visitor numbers were down 25% in 1991 from an average of 30000 per season in previous years. The mine consists of the mineral shop and mine office, a workshed, sample preparation and storage area and the quarries.

The northeast-trending vein system occurs in a fault separating Archean granite to the southeast and Sibley Group red mudstones to the northwest. The fault zone is recognized by a breccia zone along the side of a prominent ridge formed by the granite. Each of the 3 pits has been developed in the side of this ridge. The breccia zone is approximately 10 m wide and consists of granitic fragments up to 30 cm in size, Sibley Group mudstone fragments, usually less than 10 cm in size, and some fragments which are themselves composed of breccia derived from an earlier generation of faulting. The strike extent of the zone is approximately 1 km, but the consistency of the breccia zone along strike has yet to be determined through either drilling or stripping.

The main pit, the largest excavation, is the first one reached via the bush road from the mine office and is shown in Figure 9.3. The cliff wall is exposed for 70 m and consists of pink granite, some narrow zones of breccia, and veins of amethyst and barite. The rock has been blasted to the original bottom of the cliff and now forms a rubble pile 5 m high. Sibley Group red mudstone outcrops in a few places within the rubble pile or along the edge of the cliff. The breccia zone is between the granite and the Sibley Group mudstone where it is possible to see the 2 rock types. The breccia consists of varying sizes of granitic fragments and some Sibley Group fragments in a white-quartz, amethyst and barite matrix. Amethyst occurs in vugs and druses which contain fine crystal points. Large, orange, bladed barite crystals are splashed across the amethyst forming spectacular exposures of the 2 minerals. Seams of galena crystals occur associated with calcite.

The middle pit is a smaller excavation in the same granite ridge and is 500 m along strike from the main pit along an

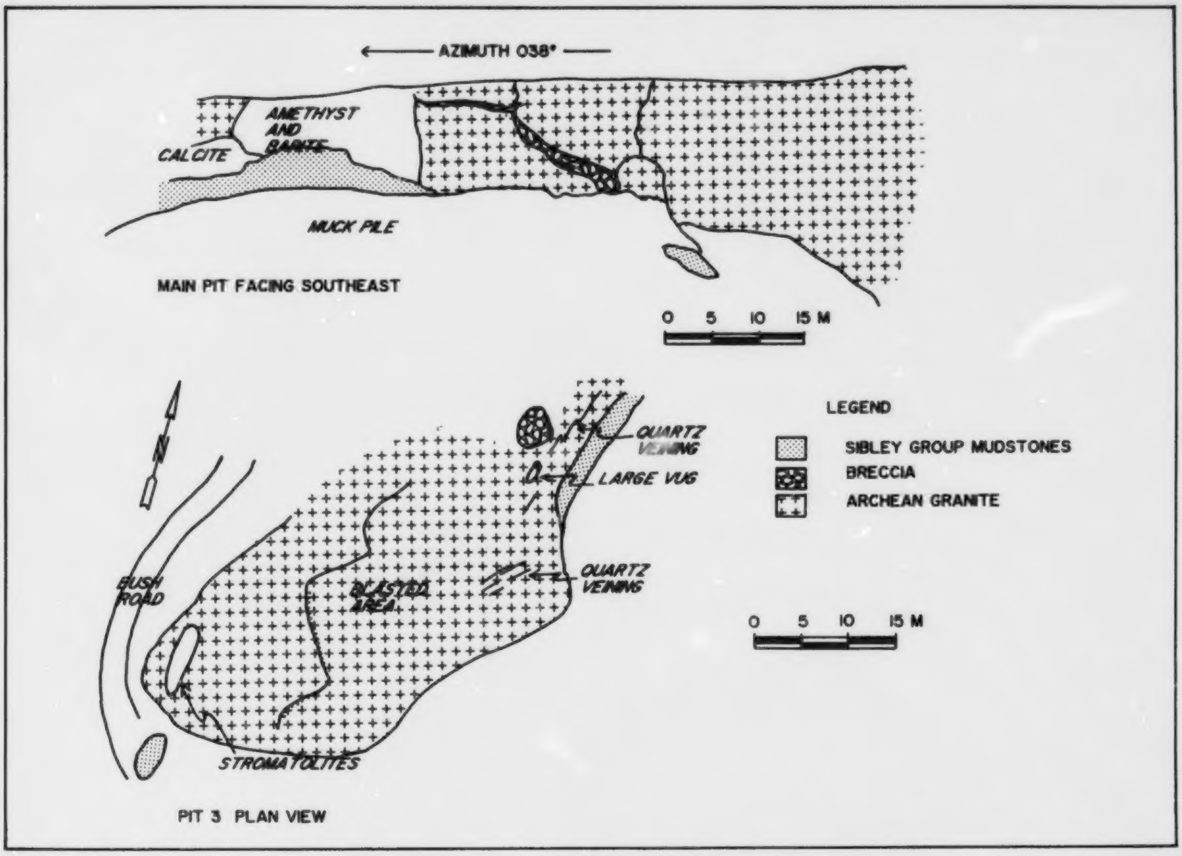


Figure 9.3. Ontario Gem Company amethyst mine showing the main quarry face (top, vertical section view) and the third pit area (bottom, plan view).

azimuth of 038°. There is good breccia exposed in this pit, with lots of vugs lined with smoky, and light- to medium-purple amethyst. There is little if any barite in this exposure.

The far pit (*see* Figure 9.3, pit 3) is 300 m from the middle pit along the same strike direction and has been blasted out of the top of the granite ridge (*see* Figure 9.3). The breccia zone is narrow, not as well defined, and occurs entirely within the granite. Where present, the breccia fragments are small and angular and are composed of Sibley Group mudstone and rebrecciated fragments of a former breccia. Alteration of the host rock by the amethyst veins is evident by kaolinization of the feldspar causing a bleaching of the granite. A set of quartz-galena veins cuts the main fault at 070°. The veins which are parallel to the main fault azimuth tend to have developed vugs. These vugs are usually only 10 cm wide, but can be quite large, as evidenced by a vug 3 m deep and 1 by 2 m wide. Amethyst from this vug was very dark purple in colour and in points 5 to 10 cm in diameter.

The granite ridge at this location is a topographic high, and appears to have also been a paleotopographic high. The thin veneer of Sibley Group rocks on top of the granite represents the Archean–Proterozoic unconformity. In hollows in the granite and toward the back side of the ridge, there are the remnants of stromatolitic chert, with amethyst crystallized between the fine laminations. Malachite staining also occurs within the stromatolites.

Pearl Lake Amethyst Mine

The Pearl Lake amethyst mine is located in McTavish Township, Concession III, south half of Lot 3. The mine site consists of a mineral shop containing amethyst gift items for sale, a workshop and sample-storage area, and a shed for the generator to supply electricity. The workings, accessible via the bush road which branches from Road 5 North in the town of Pearl, are selectively open to the public. The main products from the mine are mineral specimens for tourists and for export to mineral and lapidary clubs, and breccia stone for lapidary and landscape use.

The main fault zone trends 035° and is manifest by a breccia zone 5 to 10 m wide. There is another set of fractures and veins trending from 070° to 090°. The main fault and breccia zone separates an Archean granite-monzonite lying to the northwest from Sibley Group conglomerate lying to the southeast. Although Sibley Group rocks are not always present,

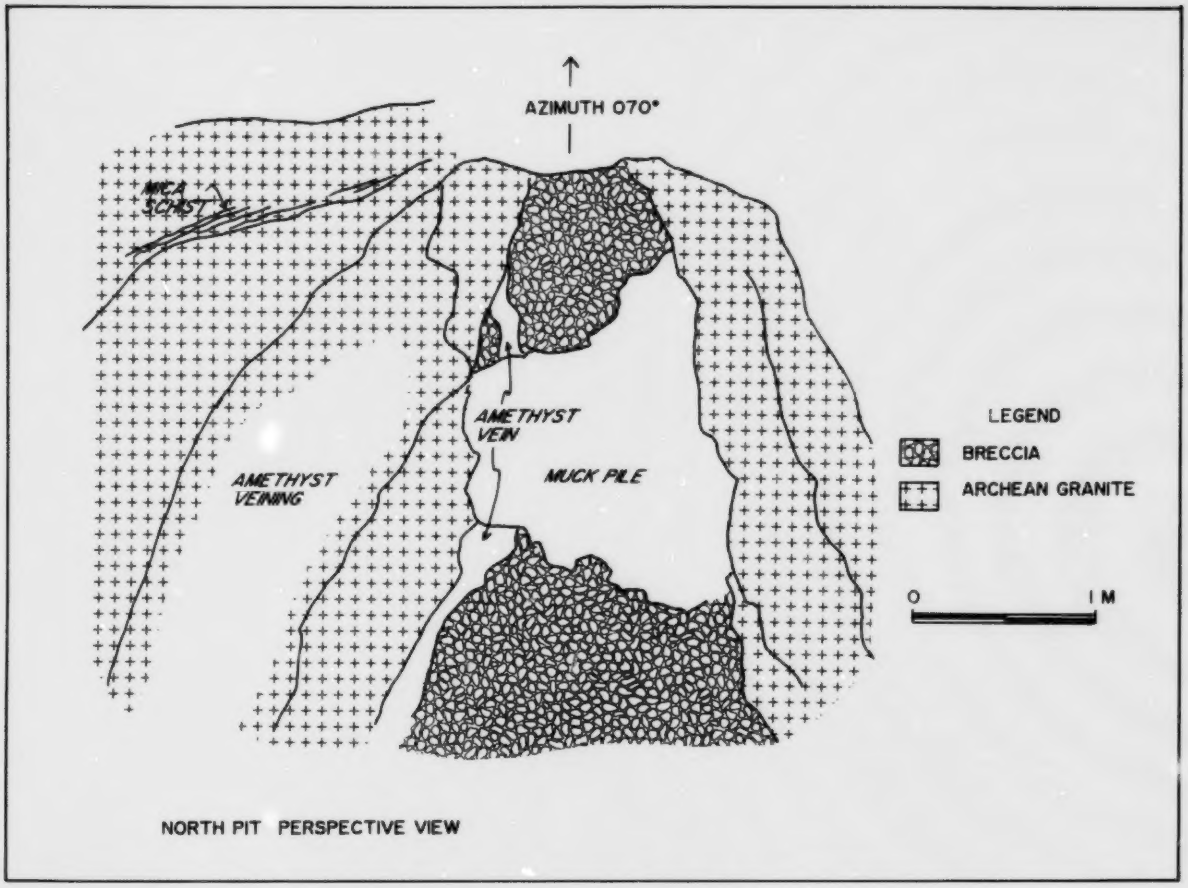


Figure 9.4. Pearl Lake amethyst mine; perspective view of the northern pit, facing northeast.

the present erosion surface represents a position close to the Archean–Proterozoic unconformity. Amethyst occurs as veins and breccia fillings in the 035° trending zone and as stringers and vug linings in the east-trending lineaments. Vugs are most prominent where the 2 fracture systems meet.

The northern working (Figure 9.4) consists of a pit blasted into the side of a granite knoll. The breccia zone strikes 070°, is 2 m wide and consists of fragments of mudstone, granite and gneissic rock. Both sides of the breccia zone are granite, and bleaching is evident along the walls. The granitic rock is quite pink, being composed of red potassium-feldspar, plagioclase and quartz. The matrix in the breccia is white quartz and amethyst, with barite occurring in the breccia between the amethyst sections and the wall rocks. The amethyst occurs in fine- to medium-sized crystals and is a dark purple colour. A vein, 30 cm wide, of dark purple, massive amethyst occurs between the breccia zone and the western granite wall.

Following the road to the southwest, the main fault zone, trending at 035°, is evident by breccia in granite outcrops and by a linear wetland. Along the edge of this wetland, Sibley Group conglomerate occurs on the southeast side of the fault and/or breccia zone. The conglomerate is quite spectacular and it consists of round granite cobbles averaging 10 cm and occasionally up to 50 cm in diameter which are set in a sandy matrix. Archean granite on the northwest side of the fault and/or breccia zone is visible where the swamp narrows to the width of the breccia zone. Amethyst occurs within the breccia and as veins associated with the breccia. Amethyst mineralization is fairly continuous in the breccia and can be mined wherever the breccia outcrops.

At the south end of the fault and/or breccia zone and on top of a granite knoll, a large vug has developed along an east-trending fracture which intersects the main fault zone. This vug is 5 m deep, 1 to 1.5 m wide and appears as a 5 m long hole at the surface. The amethyst druse that lined the walls was composed of large, dark purple crystals. The vug continues but is filled with clay. Washing and mining the vug continue.

Diamond Willow and Blue Points Amethyst Mines

The Diamond Willow and Blue Points amethyst mines were at one time just the Diamond Willow amethyst mine which was split upon death of the owner to accommodate the heirs of the estate. The mines are contiguous, however, the dividing claim line severs the original quarry. They are located in McTavish Township, Concession III, Lot 4. Access to both mines is via the gravel road which branches from Road 5 North in the town of Pearl, a distance of approximately 6 km from Highway 17. Amethyst has been known to exist in this area since the 1940s, as is indicated by the staking record. The present family obtained the original claim in 1972. These mines are known for their spectacular crystal clusters, deep-purple points, and the white and purple breccia.

The main fault and/or breccia zone trends approximately 090° over an exposed strike length of 300 m. There are 4 quarries along this zone: 1 belonging to the Diamond Willow, 2 belonging to Blue Points, and the original quarry itself which is split between the 2 mines (Figures 9.5a and 9.5b). The fault is defined by a breccia zone, 1 to 5 m wide, characterized by a quartz-rich core and fragments indicative of the wall rocks. The fault separates Sibley Group conglomerate of the Pass Lake Formation on the north side from red Sibley Group mudstone of the Rossport Formation on the south side.

The Diamond Willow pit is 70 m long and up to 10 m wide. Where exposed, the breccia zone consists of a white, massive-quartz vein, usually 0.5 to 1 m wide, graduating to a quartz-cemented breccia towards the wall rocks. Fragments of the conglomerate form the breccia next to the conglomerate wall, and fragments of mudstone occur next to the mudstone wall. Beautiful pale- to medium-purple amethyst has crystallized within cavities formed in the breccia. At the west end of the pit, galena occurs in the quartz as seams of crystals up to 1 cm in size. The conglomerate is composed of fragments of granite and shale, less than 1 cm in size, cemented by fine-grained red sand. The mudstone is very red with green reduction spots up to 5 cm in diameter. Both the conglomerate and the mudstone are well layered, giving them a very blocky appearance. Quartz veining parallel to the breccia within the mudstone results in large druse sheets of fine- to medium-sized, dark-purple amethyst crystals. Vugs within the breccia, caused by a localized lack of matrix, can be up to 1 m in diameter, and produce excellent-quality, dark-purple amethyst points. The vugs are filled with red clay which must be cleaned out to extract the amethyst.

The shared pit is almost 60 m long and 4 m deep. The wall rocks are similar to those in the Diamond Willow pit. Amethyst veining is abundant parallel to both the main fault direction and a north-trending fracture system.

The 2 pits operated by Blue Points amethyst mine have a total length of 90 m and a maximum depth of 3 m. The breccia zone appears to be continuous from G. Noyes' original pit and is similar in composition. Fragment density increases away from the quartz core but is always matrix supported. Massive calcite is present along the north wall between the conglomerate and the breccia. Quartz veining is very predominant in the mudstones. The veins have caused a green alteration for 10 cm on each side of the vein. Toward the east end of the east pit, the breccia zone diminishes to less than 1 m in width.

Thunder Bay Amethyst Mine Panorama

The Thunder Bay Amethyst Mine Panorama is located in McTavish Township on the east side of Elbow Lake, Concession IV, lots 6 and 7, and Concession V, lots 6 and 7. The mine road branches from the east side of Loon Lake Road, approximately 1 km north of Highway 17. It is 6 km to the mine site from the Loon Lake Road. Amethyst was discovered in 1935 on the shore of Elbow Lake by fishermen and again in 1955 when the government of Ontario built the access road for the fire-lookout tower. Claims were staked over the amethyst occurrence in 1957. After a series of transfers, the Thunder Bay Amethyst Company was formed in 1965, and the first claim was brought to lease in 1977. The present owner bought the mine in 1980 (assessment files, Thunder Bay Resident Geologist's office , Thunder Bay). The mine averages at least 30 000 visitors a year. Amethyst is produced for sale in the company's 2 stores and for lapidary use. Amethyst of exceptional quality is reserved for jewelry and faceting. Breccia stone is produced for landscaping and fireplace construction. The mine consists of a shop and check-in for tourists, display area, quarry, picking area, bunkhouse and workshop for mine employees, and limited residence for store staff. Tourists are not allowed in the quarry, but they can look for amethyst in the picking pile.

The main fault strikes and dips at 110°/65°S and contains a breccia zone up to 50 m wide. The fault and/or breccia zone is contained within pink granite, yet the breccia contains fragments of both granite and Sibley Group rocks. Another fracture system, trending 010°, has caused dilation where the 2 zones intersect, resulting in very large vugs and open spaces for crystallization of amethyst. Amethyst points up to 15 cm in diameter have been recovered from these vugs. Amethyst veins up to 40 cm wide occur parallel to the main-fault direction, between the breccia zone and the granite walls, and also along the northerly fracture direction, particularly in the east end of the pit. The large, outer part of the amethyst crystals is a very dark purple in colour, but several crystallization sequences are usually visible, and these vary from colourless quartz to white chalcedony to pale- and medium-purple amethyst. Good gem-quality amethyst requires colour saturation throughout the crystal and good clarity, without inclusions and hematite spots. Dark-purple amethyst from the large veins is frequently gem quality. Spectacular crystal clusters have been removed from vugs with the larger vugs producing larger crystals. Quartz needs freedom to grow, and the space provided by dilational features, such as vug development, provides this uncontested growth environment.

North of MacGregor Area

The North of MacGregor area is a tract of unsurveyed territory north of MacGregor Township that is referred to on plan G-672

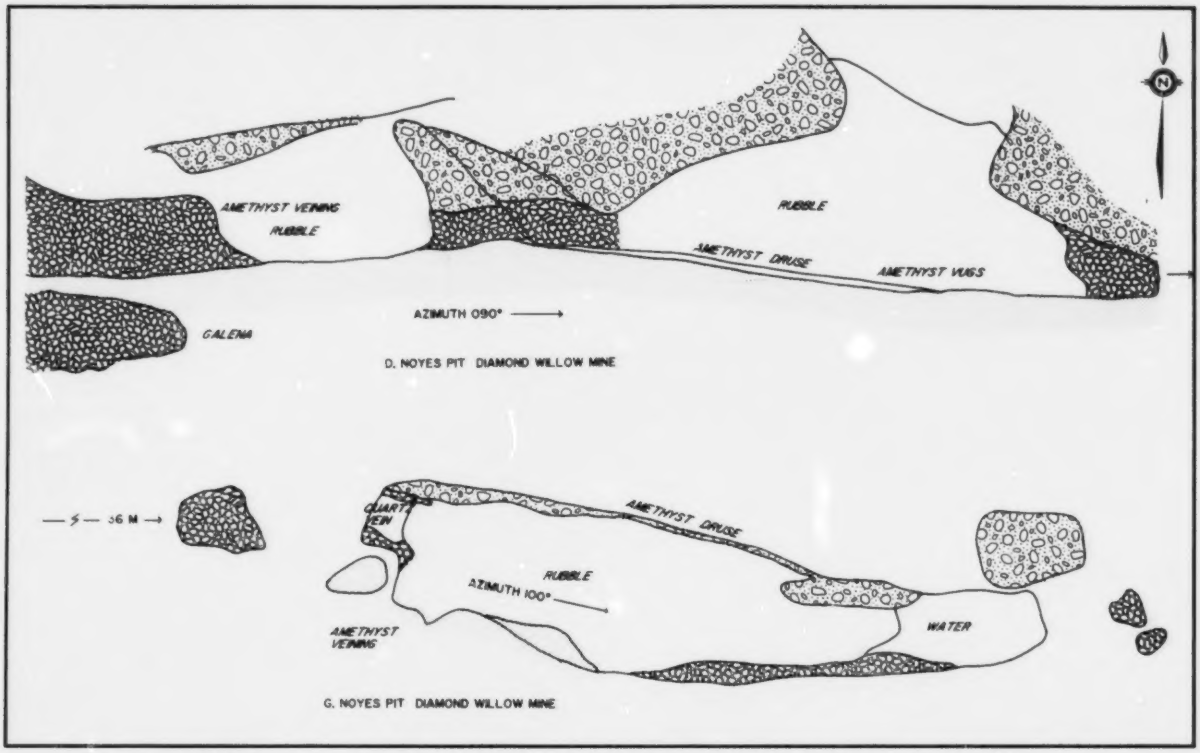


Figure 9.5a. Diamond Willow amethyst mine showing D. Noyes pit (top) and G. Noyes original pit (bottom) in plan views.

as the North of MacGregor Area. For a record of staking activity in this area, the MacGregor Township claim map (G-672) is used. Prior to the construction of a forest-access road built by Canadian Forest Products, the only way into the area was via a bush road going north from MacKenzie Station.

Amethyst has been noted for a long time by fishermen and hikers who accessed that area. The first staking was done in 1967, and restaking occurred during subsequent years until the present owners of the various claim groups acquired the mineral rights. J. Scott, Staff Geologist for the Thunder Bay Resident Geologist's District, noted several amethyst and quartz showings in his mapping of the township from 1984 to 1985 (Scott 1990). Prospecting in the last 2 years has revealed amethyst occurrences throughout the North of MacGregor area.

The township is underlain by Archean rocks; the only Proterozoic rocks that are present outcrop along the shore of Lake Superior. The geology in detail is described in Open File Report 5719 by J. Scott (1990). The host rock to the amethyst veins is a massive, uniform red granite. Rafts and blocks of a grey, schistose quartz-biotite metasediment are present within the granite.

The amethyst occurs as druse lining vein systems which are predominately quartz stringers unless the vein has opened up to allow for crystallization of amethyst points. Vug development can occur along the fractures with no indication as to why. The vein systems strike either 090°, 045° or 180° with all values accurate to 010°. Breccia zones are usually absent unless the vein system is extensive, and then the breccia zone is in the 1 to 2 m width range. Where well-developed vein systems are present, the amethyst is of excellent quality, forming equidimensional points from 1 to 3 cm in diameter in druse and crystal clusters of a medium- to very-dark-purple colour. Citrine and green quartz have also been noted in some veins (Figure 9.6).

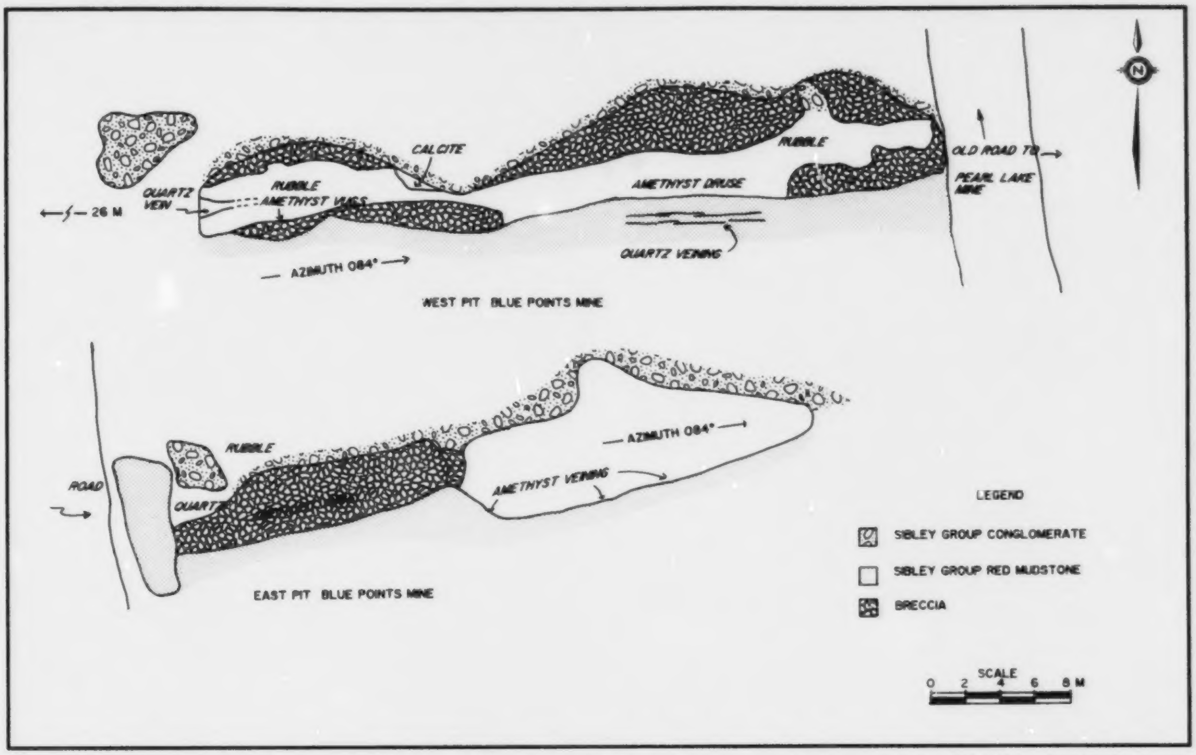
RECOMMENDATIONS FOR EXPLORATION

The formation of amethyst, as opposed to white quartz, requires a particular set of conditions to prevail. These are as follows:

1. precipitation of quartz from hydrothermal solutions containing ferric iron in a near-surface oxidizing environment

2. a source of ionizing radiation

3. a system of open fissures or cavities allowing the quartz to crystallize in a noncompetitive environment (Cohen 1985, 1989).


CALCITE
RUBBLE
QUARTZ VEIN
RUBBLE
AMETHYST VUGS
AMETHYST DRUSE
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OLD ROAD TO
PEARL LAKE MINE
← 26 M
AZIMUTH 084°
QUARTZ VEINING
WEST PIT BLUE POINTS MINE
N
RUBBLE
ROAD
QUARTZ
AZIMUTH 084°
AMETHYST VEINING
EAST PIT BLUE POINTS MINE
LEGEND
SIBLEY GROUP CONGLOMERATE
SIBLEY GROUP RED MUDSTONE
BRECCIA
SCALE
0 2 4 6 8 M

Figure 9.5b. Blue Points amethyst mine showing the 2 pits separated by the mine-access road. The arrow to the left of the sketch of the west pit indicates direction and distance to the G. Noyes pit shown in Figure 9.5a.

The source of solutions rich in quartz is interpreted to have formed from evolved basin brines that were expelled from the Sibley Group rocks (McArthur and Kissin 1988). Iron is present throughout the Sibley Group rocks as is evidenced by the red, hematitic siltstones and sandstones, and the Gunflint Formation taconites. Ionizing radiation is present in the Archean granite bodies and to some extent within the Sibley Group; moreover, the unconformity between the Archean and Proterozoic rocks appears to have concentrated radioactive minerals, thus, accounting for the spacial relationship of the amethyst to the unconformity. With this in mind, any area with potential for amethyst formation should exhibit the following characteristics:

1. Abundant quartz veining; stringers and network veins of quartz, rather than 1 massive pegmatitic vein; silica saturation throughout the rock is more indicative of the probability of amethyst development.

2. Evidence of ionizing radiation—either indirectly by recognizing the location of the unconformity, or directly by the colour of any quartz present or by the recognition of radioactive minerals.

3. Iron is required, with radiation, for the formation of the purple colour in amethyst, but the iron must be in the solutions prior to crystallization, thus, iron-rich rocks do not need to be present at the crystallization site.

4. Open fissures and cavities; it is essential for quartz to crystallize in points; vugs can occur anywhere along the strike of fractures, but are best developed where 2 fracture systems intersect; vugs also occur between the pieces in the fault breccias; the potential is higher along strike of any of the major 045° trending lineaments.

MacGregor Township and North of MacGregor Area

The mapping published in Open File Report 5719, by J. Scott (1990), notes several amethyst occurrences, and work done in 1991 has realized the potential for this area. Access into the northern part of the township, including the North of MacGregor area, is better now with the completion of new logging roads, and several new amethyst occurrences—one of which is now producing—have been staked by prospectors. The MacKenzie granite appears to be a favourable host rock for a source of radioactivity and for vug development.

McTavish Township

Although heavily staked, especially along the exposed unconformity, locations anywhere along the unconformity that are not staked deserve attention, and if exposure is poor, then stripping or drilling may be necessary. The granitic rocks near known lineaments, in the northern part of the township, have potential.

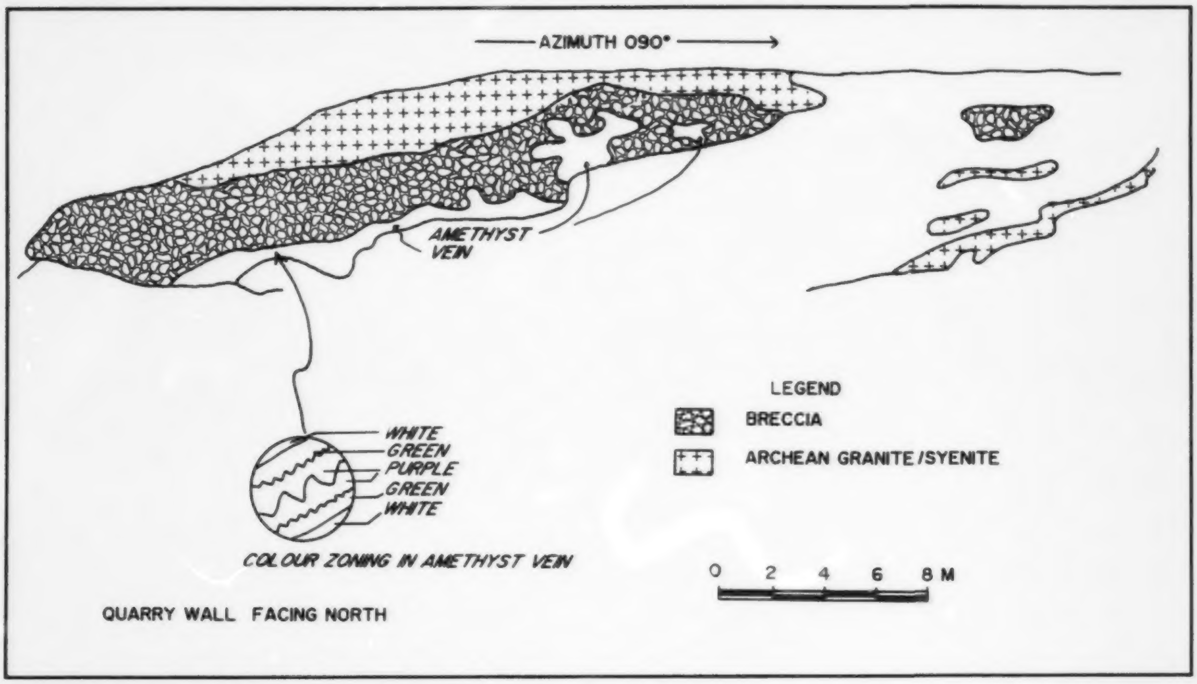

Figure 9.6. Amethyst vein in North of MacGregor Area, Blue Star Resources quarry.

Jean Township

The northwest-trending lineament and Proterozoic inlier in Jean Township make this area interesting, especially since there is a record of silver occurrences (Tanton 1931), and veins of amethyst have been found associated with the fracture system.

RESEARCH BY OTHER AGENCIES

Lakehead University Studies

The following investigation, provided in a reference format, is currently underway at Lakehead University, Thunder Bay:

McArthur, J.R., Jennings, E.A., Kissin, S.A., and Sherlock, R.L., in preparation. Stable isotope, fluid inclusion and mineralogical studies relating to the genesis of amethyst, Thunder Bay Amethyst Mine, Ontario.

SELECTED PUBLICATIONS RECEIVED

Sabina, A. 1991. Rocks and minerals for the collector, Sudbury to Winnipeg; Geological Survey of Canada, Miscellaneous Report 49, 315p.

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Cohen, A.J. 1985. Amethyst colour in quartz, the result of radiation protection involving iron; American Mineralogist, v.70, p.1180–1185.

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Garland, M.I., in press. The Thunder Bay amethyst deposits; *in* Geology of Ontario, Ontario Geological Survey, Special Volume 4, pt.2.

McArthur, J.R. and Kissin, S.A. 1988. Stable isotope, fluid inclusion, and mineralogical studies relating to the genesis of amethyst, Thunder Bay Amethyst Mine, Ontario, Canada; *in* Program with Abstracts, Geological Society of America, 1988 Annual Meeting, v.20, p.A40.

Patterson, G.C. 1985. Amethyst in the Thunder Bay area; Resident Geologist's files, Thunder Bay Resident Geologist's District, Thunder Bay.

Scott, J. 1990. Geology of MacGregor Township; Ontario Geological Survey, Open File Report 5719, 82p.

Tanton, T.L. 1931. Fort William and Port Arthur, and Thunder Cape map-areas, Thunder Bay District, Ontario; Geological Survey of Canada, Memoir 167, 222p.

10. Field Services Section, Northeastern Ontario: Introduction

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Manager, Field Services Section (Northeast) Ontario Geological Survey – Information Services Branch

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This past year of 1991 has brought many changes to the Mines and Minerals Division of the Ontario Ministry of Northern Development and Mines through the reorganization of the division and the implementation of changes to the Mining Act. The division's reorganization resulted in the Mineral Resources Section's name being changed to the Field Services Section of the Ontario Geological Survey's Information Services Branch. Reorganization also resulted in the demise of the division's former regional tripartite structure, although the Field Services Section currently continues to operate within a regional tripartite framework.

The goal of the Field Services Section is to provide professional consultative services and advice on the geology, the mineral deposits and the exploration and mining activities within the province to prospectors, mineral-exploration companies, internal-government agencies, private-interest groups and the public. Other goals are to attract, stimulate, guide and monitor mineral exploration and development. This is primarily accomplished through the Resident Geologist Program.

Within northern and northeastern Ontario in an area that exceeds 444500 km^2, the Resident Geologist Program is currently comprised of 6 Resident Geologists' districts within the 4 mining divisions of Sudbury, Sault Ste. Marie, Porcupine and Larder Lake. The various Resident Geologists' district offices are located in the following centres: Sudbury, Sault Ste. Marie, Wawa, Timmins, Kirkland Lake and Cobalt. The Resident Geologist Program also encompasses the Drill Core Library System. Drill core libraries are located in Timmins, Swastika (Kirkland Lake) and Sault Ste. Marie, with a satellite facility located in Cobalt. A Regional Staff Geologist, operating from the drill core library facility in Swastika, and a Staff Geologist (Mineral Development Consultant), located in Elliot Lake as part of the ministry's Elliot Lake Special Geological Reassessment Project, rounded out the 1991 northeastern contingent of the Field Services Section.

In the course of performing their duties and responsibilities during 1991, northeastern Field Services Section staff responded to over 11 200 office and telephone queries and conducted in excess of 225 field visits to exploration and mining sites.

In addition to providing these professional consultative and advisory services, the Field Services Section staff in each district performed other tasks and participated in numerous functions including:

- the preparation and delivery of basic prospecting courses in the communities of Kapuskasing, Kirkland Lake, Cobalt, Sudbury and Elliot Lake
- the provision of technical information and recommendations to other government ministries and agencies on environmental and land-use-planning issues
- conducted field trips for representatives from exploration and mining companies, universities, schools, government, foreign governments and industry, and the public
- gave talks to schools and tourists at local provincial parks on geology and related topics
- established public-information booths in local malls and at drill core library facilities in support of Mining Week, Ontario Geological Survey Centennial celebrations and other local geology-related events

- presented poster displays and gave talks at the Ontario Mines and Minerals Symposium and the Northeastern Ontario Regional Geoscience Seminar which were held in Toronto and Kirkland Lake, respectively
- participated on several ministerial committees and working groups.

Several projects were completed by northeastern Field Services Section staff during 1991. These projects, listed below, include those related to the 4 year Wawa Economic Development Initiatives funded by the Northern Development Fund under the supervision of Resident Geologist Delio Tortosa, and those initiated in other resident geologists' districts:

- Computer Applications (Desktop Geographic Information Systems) compiled into a format comprising digital maps and data bases—by R. Henri and P. Beach
- Compilation and Organization of Mineral Resource Information which have been published as 14 geological data inventory folios (GDIFs)—by C. Lowe
- Evaluation of Mineral Resources, Granitic and Gneissic Terranes which is available as an Open File Report—by A.C. Wilson
- Development of a Computerized Mineral Deposits Data Base which is discussed in an Open File Report—by E.D. Frey and R.C. Stewart
- Mineral Occurrence Investigations in Esquega and Corbiere townships presented within an Open File Report—by P.C. Delisle
- The Algoma Central Railway Exploration File Consolidation; *see* assessment files, Resident Geologists' offices, Wawa and Sault Ste. Marie Resident Geologists' districts
- Precious Metal Study: Sudbury–Espanola Area (*see* Sudbury Resident Geologist's office files)—by B. Gates
- A permanent geology display for the Providence Bay Interpretive Centre on Manitoulin Island—by B. Gates
- GDIFs for 5 townships in the north Swayze area and a data compilation of the Partridge River area (*see* Timmins Resident Geologist's office files)—by D.M. Draper
- Minerals Exploration Services Data Base established at the Kirkland Lake Resident Geologist's office—by D.L. Guindon
- Report entitled *The Sedimentary Phase that Initiated the Concentrating of Matachewan–Kirkland Lake–Larder Lake, Ontario, and Other Similar Gold Ores prior to Their Modification by Metamorphism* which is in preparation at the Kirkland Lake Resident Geologist's office—by H. Lovell
- Field guidebook prepared for the Society of Economic Geologists entitled *Archean Gold Deposits of the Matachewan–Kirkland Lake–Larder Lake Area, Ontario, Canada*—edited by H. Lovell, D.R. Robinson and D.L. Guindon
- Report and editing for a contribution to the *Geology of Ontario*, Special Volume 4, Part 1, and one of its integrated map-folio themes, *Tectonic Assemblages of Ontario*, with input being specific to those assemblages pertaining to the Huronian Supergroup—by G. Bennett.

The Mineral Deposit Index (MDI) portion of the Geoscience Exploration Database (GED) Project was completed for most of northeastern Ontario during 1991. Approximately 700 records remain to be entered into the Kirkland Lake and Sudbury Resident Geologists' office data bases.

When completed in early 1992, the entire MDI data base for northeastern Ontario will consist of over 5600 individual mineral-occurrence records. The MDI data files are currently available for viewing upon request at all northeastern Resident Geologists' offices. The digitizing of the MDI locations on 1:50000 scale topographic maps is expected to be completed in 1992. Staff at the drill core library in Timmins collected and/or received over 4760 m of diamond-drill core during 1991. This brings the total amount of drill core currently stored at this facility to approximately 148190 m representing 3918 diamond-drill holes. Similarily, the Swastika Drill Core Library's staff collected and/or received 10250 m of drill core during the past year, bringing their total to 184290 m of drill core from 2134 diamond-drill holes, while the Sault Ste. Marie Drill Core Library's staff collected and/or received 4760 m, bringing their total of stored drill core to more than 92000 m representing 1340 diamond-drill holes. In addition, the Cobalt Resident Geologist's office received 4185 m of diamond-drill core during 1991, bringing their total of stored drill core to approximately 20970 m. The Sudbury Resident Geologist's office also accepted 11900 m of drill core in 1991 which is currently stored at a government compound near McFarlane Lake.

The 11th Annual Northeastern Ontario Regional Geoscience Seminar was held in Kirkland Lake during 1991. This seminar drew an attendance approaching 300 persons to view 59 poster displays and listen to 9 talks presented by a guest speaker and both government and industry representatives. Nineteen of the poster displays were provided by representatives from the exploration and mining community and from various universities.

Several personnel changes took place within the northeastern Field Services Section during 1991. D. Tortosa resigned from his position as Resident Geologist for the Wawa Resident Geologist's District to pursue interests in the private sector. The Wawa office is currently under the administration of G. Bennett, Sault Ste. Marie Resident Geologist, while on-site technical and geological services are provided by Staff Geologist A. Wilson who assumed these responsibilities in August, 1991. J. Ireland became the Resident Geologist in Cobalt and Acting Manager of the Temiskaming Testing Laboratories after successfully competing for the positions midway through 1991. Upon his retirement from the ministry in the fall of 1991, J. Robertson, Mineral Development Consultant in Elliot Lake, was replaced by Staff Geologist M. Hailstone, former Staff Geologist in the Kenora Resident Geologist's District. M. Hailstone now reports to the Resident Geologist in Sault Ste. Marie. D. Guindon was successful in winning the competition for Staff Geologist, Kirkland Lake Resident Geologist's District. His former position as Drill Core Library Geologist in Swastika was filled by Z. Madon who joined the ministry from private industry. In November, 1991, W. Meyer returned to his former position as Resident Geologist, Sudbury Resident Geologist's District, following his secondment to the Planning and Information Office of the Mines and Minerals Division. During W. Meyer's secondment, the Resident Geologist's position was temporarily filled by M. Cosec, Staff Geologist, Sudbury Resident Geologist's District.

Exploration activity continued to diminish throughout northeastern Ontario during 1991. By the year's end, the number of mining claims in good standing (16 hectare units) for the 4 mining divisions in northern and northeastern Ontario was approximately 57850 units.

Apart from the exploration projects being conducted by major mining companies, a large proportion of the exploration activity that took place consisted of grassroots exploration projects that were partially funded under the Ontario Prospectors Assistance Program (OPAP) and the Ontario Minerals Incentive Program (OMIP). During 1991, 220 OPAP grants totalling approximately $2.4 million were awarded to recipients working on exploration projects in northeastern Ontario, while 96 projects were supported by funding under OMIP to the total sum of approximately $10.3 million.

Advanced exploration projects within northeastern Ontario during 1991 included:

- mine development at the Lower Coleman Mine, the McCreedy East Mine (ore reserves of 32.5 million tons grading 2.27% Cu, 1.58% Ni and 0.071 ounce precious metals per ton), the Craig Mine (expected nickel production of 45 million pounds annually), and the Strathcona Mine and the Thayer Lindsley deposit, all of which lie within the Sudbury Resident Geologist's District

- underground exploration at the Paymaster Mine (ore reserves of 500000 tons grading 0.33 ounce Au per ton between 6000 and 6600 feet below surface), and surface exploration at the Claude Rundle Mine (ore reserves of 534820 tonnes grading 6.53 g/t Au), both within the Timmins Resident Geologist's District

- surface exploration on the Spirit Lake Exploration Ltd. Edward's gold property, and a feasibility study on the Eagle River gold deposit (the project is currently on hold with ore reserves of 2.87 million tons grading 0.25 ounce Au per ton), both located within the Wawa Resident Geologist's District

- a positive feasibility study on the Lightning Zone and Teddy Bear deposits (combined ore reserves of 5.5 million tons grading 0.27 ounce Au per ton) within the Kirkland Lake Resident Geologist's District.

Other significant mineral-exploration discoveries made during 1991 include Inco Limited's copper-nickel discovery near the former Victor Mine on the East Range of the Sudbury Basin, in Maclennan Township (preliminary ore-reserve estimates in 2 separate zones stand at 4.6 million tons grading 7.30% Cu and 2.25% Ni, and 7.0 million tons grading 0.50% Cu and 2.17% Ni), and Fort Knox Gold Resources Inc.'s copper-nickel and copper-lead-zinc discoveries in Fawcett Township. In addition to these, several potential building- and decorative-stone quarry sites were identified, primarily within the Sudbury Resident Geologist's District, as well as industrial-mineral deposits, including kyanite in Butler and Antoine townships in the North Bay area.

A total of 55 mines and quarries throughout northeastern Ontario were in operation during all or part of 1991, producing numerous commodities including uranium, base and precious metals, building and decorative stone and industrial minerals. However, by the end of 1991, this number had been reduced to 45 following either the permanent closure or the suspension of operations at the following mining or quarrying locations: Renabie Mine, Bell Creek Mine, Langmuir No.1 Mine, Buffonta Mine, New Kelore Mine, Falconbridge No.5 Shaft, Creighton No.3 Shaft, the Garson and the Whistle open-pit mines, as well as Eastmaque's gold tailings-reclamation operations in Kirkland Lake.

Gold producers included the following: the Magino and Renabie mines in the Wawa Resident Geologist's District; the Dome, Detour Lake, Bell Creek, Hoyle Pond, and Pamour No.1 mines, and the Pamour No.3 and No.5 open pits in the Timmins Resident Geologist's District; and, the Holt-McDermott, Kerr, Macassa, Cheminis, New Kelore and Buffonta mines, as well as the Eastmaque and Lac Minerals gold tailings-reclamation projects, in the Kirkland Lake Resident Geologist's District.

Base metal production in the Sudbury Resident Geologist's District came from 9 underground and 2 open-pit mines operated by Inco Limited, and 5 underground and 1 open-pit mines operated by Falconbridge Limited; and from Falconbridge Limited's Kidd Creek Mine, Timmins Nickel Inc.'s and BHP Utah Mines Ltd.'s Redstone Mine and Timmins Nickel Inc.'s Langmuir No.1 Mine in the Timmins Resident Geologist's District.

Iron ore was mined at the G.W. McLeod Mine in Wawa by the Algoma Ore Division of the Algoma Steel Corporation, while uranium was mined at Rio Algom Ltd.'s Stanleigh Mine and the Denison Mine in Elliot Lake. Denison's Elliot Lake operations are scheduled to close by April, 1992.

The production of industrial minerals and both building and decorative stone came from numerous mines and quarries operating on either a continual or seasonal basis. These included, but are not limited to, the following: the Root River sandstone quarry and Ontario Trap Rock Ltd.'s diabase quarry in the Sault Ste. Marie Resident Geologist's District; Luzenac Incorporated's talc mine in the Timmins Resident Geologist's District; Extender Minerals of Canada Ltd.'s underground barite mine and Hedman Resources Ltd.'s lizardite open-pit mine in the Kirkland Lake Resident Geologist's District; Dymond Clay Products Limited's 2 limestone quarries, McLaren's Bay Mica Stone Company's quarries and Thorne Brilliant Stone Quarry in the Cobalt Resident Geologist's District; and, Standard Aggregates Incorporated's dolomite quarry, Carman Construction Incorporated's silica quarry, Crea-Mac Contracting Company Limited's pink-feldspar quarry and Hercules Stone Limited's limestone quarry in the Sudbury Resident Geologist's District.

In 1991, the long-standing land-claim dispute between the Teme-Augama Anishnabai First Nation—also known as the Bear Island Band—and the province of Ontario was settled by the Supreme Court of Canada. This dispute led initially to the establishment in 1973 of the Temagami Land Caution and the subsequent implementation of a Withdrawal from Staking Order being imposed by the provincial government on the surrounding lands contained within 110 townships. Prior to the release of the Supreme Court of Canada's decision, the 2 sides entered into negotiations with the resolve to reach a settlement that would be to the mutual satisfaction and benefit of both parties.

The Supreme Court of Canada found in favour of the province. However, in keeping with the spirit of co-operative consultation as agreed upon earlier, the province is continuing to negotiate a settlement with the Teme-Augama Anishnabai First Nation. Nonetheless, the four townships of Strathy, Cassells, Best and James, currently within the Temagami Land Caution area, will be reopened for staking effective January 7, 1992. This action is heralded with cautious optimism by the minerals-exploration community and may be seen as a possible catalyst to help stimulate exploration activity, not only within the affected lands but also throughout the province.

The signing of the Northern Ontario Development Agreement (NODA) in the autumn of 1991 between the Ontario provincial and federal governments translates into the spending of $30 million over the next 5 years on geological research and field-related projects. This program too is seen as a very positive step in an effort to stimulate the economy of minerals exploration and mining throughout the north.

11. Wawa Resident Geologist's District—1991

A. C. Wilson

Geologist, Wawa, Field Services Section, Ontario Geological Survey – Information Services Branch

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INTRODUCTION

Exploration activity in the Wawa area has undergone a decline of approximately 30% compared to last year. Figure 11.1 and the accompanying table (Table 11.1) provide an overview of the active exploration programs in the district. Also, there has been a significant decrease in the volume of new assessment files received by the Resident Geologist's office.

Claim staking and recording levels for the district are unchanged from those of 1990. For a graphic representation of claim-staking activity and assessment work filed for the Sault Ste. Marie Mining Division, *see* the Sault Ste. Marie Resident Geologist's report, this volume.

With the closure of the Renabie Mine in September, the number of producing mines in the district has returned to the pre-1985 level of two (Figure 11.2). New mine production also has been delayed; Hemlo Gold Mines Inc. recommended that mining of the Eagle River gold deposit be deferred until production costs are reduced and the price of gold improves (*The Northern Miner*, February 25, 1991, p.1).

Not all of the 1991 news is bad. It is encouraging to note that although exploration activity in the district has dropped, interest in the area has not waned. In addition to retaining levels of client requests and office visits similar to those in 1990 (Figure 11.3), the number of companies expressing a new or renewed interest in the district has actually increased. Six individual prospectors from the Wawa area received Ontario Prospectors Assistance Program (OPAP) grants totalling $60 000. Two other OPAP grants that are being applied to projects in the district were given to prospectors from outside of the Wawa area.

Ontario Mineral Incentive Program (OMIP) grants totalling $532 833 were made to 11 companies active in the district.

The results of the 1990–1991 drilling program at the Edward's property in the Goudreau area (Spirit Lake Exploration Ltd.) indicate a potentially mineable ore body on the property (D. Hendrick, Spririt Lake Exploration Ltd., personal communication, 1991). Financing arrangements for the extraction of a bulk sample have begun.

Mining Activity

ALGOMA ORE DIVISION

Mining of siderite ore continued at the G. W. MacLeod Mine in Wawa. The mine is operated by the Algoma Ore Division of the Algoma Steel Corporation Limited. Production to the end of December was 1 149 224 gross tons of sinter from 947 535 gross tons of mine ore, with an average grade of 34.5% iron. In 1991, 123 600 feet of blast holes were drilled, 4495 feet of stopes were developed and 763 feet of raising was undertaken. The mine currently has a developed ore reserve of 8 million tons.

In October 1991, Algoma Ore Division received permission from the Ontario Ministry of the Environment to proceed with tests involving the Dofasco summer mixture (*The Algoma News Review*, November 13, 1991, p.14). These tests involved the use of iron-bearing mill waste (mill scale and oxides) from Dofasco Inc.'s Hamilton steel mill in the Wawa sintering process to reduce the amount of sulphur-dioxide discharge from the sintering plant (*The Sault Star*, May 30, 1991, p. A1). Over 100 elements will be analysed from the stack sampling program conducted by MANN Consultants, Mississauga. The results have yet to be released (*The Algoma News Review*, November 13, 1991, p.14).

Algoma Ore Division's parent company, Algoma Steel Corporation Limited, is currently working on restructuring its debt. The possible closure of the Sault Ste. Marie steel plant would likely result in the closure of the Algoma Ore Division.

Magino Mine

The Magino Mine is jointly owned by Muscocho Explorations Limited (50%) and McNellen Resources Inc. (50%). Ore reserves in all categories, at the end of 1990, was estimated to be 1.2 million tons with an average grade of approximately 0.156 ounce Au per ton.

Mining and milling operations continued through the year at an average daily mill through put of 646 tons per day. Gold production to the end of September was 22559 ounces. Production came mainly from the 150, 250, 300, 350, 400 and 500 foot levels. Estimated annual gold production is 28000 ounces. The mill operates at a capacity of 700 tons per day, a 200-ton-per-day increase that was achieved in the first quarter of 1991. The mine and mill employ an average of 100 employees.

The orebody is accessed by a spiral decline with levels at 100, 150, 200, 250, 300, 350, 400 and 500 feet below surface. A total of 9654.1 feet of underground development (ramping, level drifting, raising and stope preparation) occurred on all levels to the end of October. Definition and underground exploration drilling, so far this year, totalled 1081 feet. (A. J. Deevy, Muscocho Explorations Limited, personal communication, 1991).

Long-hole stopes accounted for 80% of stope muck, with

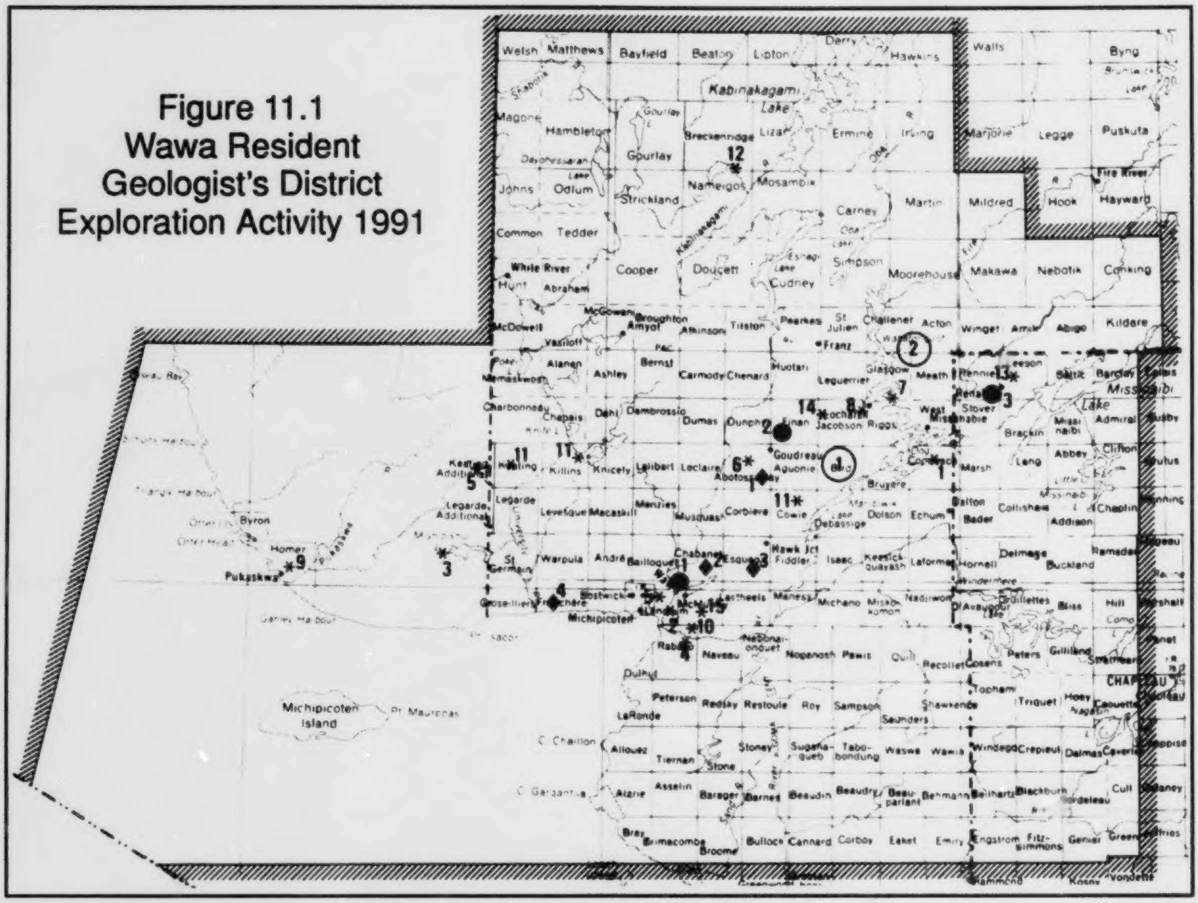


Figure 11.1
Wawa Resident
Geologist's District
Exploration Activity 1991
Welsh
Matthews
Bayfield
Beaton
Lipton
Derry
Hawkins
Walls
Byng
Kabinakagami Lake
Magone
Hambleton
Gourlay
Breckenridge
Lizar
Ermine
Irving
Marjorie
Legge
Puskuta
12
Odlum
Nameigos
Mosambik
Johns
Strickland
Carney
Martin
Mildred
Hook
Hayward
Fire River
Common
Tedder
Simpson
White River
Hunt
Abraham
Cooper
Doucett
Cudney
Moorehouse
Makawa
Nebotik
Conking
McGowan
McDowell
Broughton
Amyot
Atkinson
Tiston
Pearkes
St. Julien
Challener
Acton
Winget
Kildare
Vasiloff
Franz
2
Alanen
Ashley
Bernst
Carmody
Chenard
Huotari
Leguerrier
Glasgow
Meath
Rennie
13
Leeson
Barclay
Stover
3
Missinaibi Lake
Admiral
Charbonneau
Chapais
Dahl
Dembrossio
Dumas
Dunphy
2
Finan
Jacobson
Riggs
West
Missinabie
14
8
7
Brackin
11
11
Killins
Knicely
Lalibert
Leclaire
6
Abotossaway
Goudreau
Aguonie
1
Bird
Bruyere
Marsh
Lang
Abbey
Clifton
Keefer
Additional
5
Legarde
Additional
Legarde
Levesque
Macaskill
Menzies
Musquash
Corbiere
11
Cowie
Debassige
Dolson
Echum
Bader
Collishaw
Addison
Chaplin
Byron
Homer
9
Pukaskwa
3
St. Germain
Warpula
Andre
Bailloquet
Chabanel
Esquega
3
Hawk Jct
Fiddler
Isaac
Keesick
Quayash
Laforme
Hornell
Delmage
Buckland
Odlum
1
4
Gosselin
Rabazo
Bostwick
Lendrum
5
15
Leitheels
Manes
Michano
Misabi
Nadjiwon
Avausjour
Gaillettes
Bliss
Hill
Michipicoten
2
10
Nebonaionquet
Rabazo
4
Naveau
Noganosh
Pawis
Quill
Recollet
Cosens
Peters
Gilliland
Dubreuil
Topham
Triquet
Hoey
Chapleau
Petersen
LaRonde
Redsky
Restoule
Roy
Sampson
Shawkence
Saunders
Michipicoten Island
Allouez
Tiernan
Stone
Stoney
Sugarbug
Tabobondung
Waswa
Wawia
Windego
Crepieul
Dalmas
Cull
Asselin
Alzie
Barager
Barnes
Beaudin
Beaudry
Beauparlant
Behmann
Belhartt
Blackburn
Bray
Brimacombe
Broome
Bulloch
Cannard
Corboy
Eaket
Emiry
Engstrom
Fitzsimmons
Genier
Green
Hammond
Vondette

EXPLANATION

Exploration Activity in 1991 (keyed to Table 11.1)

● Producing Mines, 1991

1. G.W. MacLeod Mine (Algoma Ore Division) .... Fe
2. Magino Mine (Muscocho Explorations Limited/McNellen Resources Inc.)..... Au
3. Renabie Mine (Renabie Gold Mines Ltd.) .... Au (closed September 1991)

Location of OGS Field Party in 1991

① T.F. Morris
② E.A. Vida, J.A.C. Fortescue and D.R. Wadge

◆ Property Description (included in this report)

1. Kozak Property
2. Mammoth Metals Occurrence
3. Regnery Molybdenite Occurrence
4. Crane Deposit

Table 11.1. Exploration activity during 1991.

Number on Figure 11.1	Company/Individual	Activity
1.	J. Anglehart	prospecting, stripping and trenching
2.	C. Clement	stripping and diamond drilling
3.	D. Carroll	prospecting, stripping and trenching
4.	J. Cureatz	diamond drilling and prospecting
5.	J. Gerdes	prospecting
6.	Gold Fields (Canadian) Mining Corporation	prospecting, geochemical sampling and diamond drilling
7.	Lac Minerals Ltd.	prospecting, geochemical mapping and geochemical sampling
8.	Loydex Resources Inc.	stripping, trenching, and geochemical sampling
9.	Mishibishu Gold Corporation	diamond drilling
10.	Monk Gold and Resources Ltd.	dewatering of decline and geochemical sampling
11.	Noranda Exploration Company Ltd.	prospecting, geological mapping, geophysical surveying and geochemical sampling
12.	J. Partington	prospecting
13.	Renabie Gold Mines Ltd.	trenching and geochemical sampling
14.	Spirit Lake Explorations Ltd.	diamond drilling
15.	Van Ollie Explorations Ltd.	geological mapping, geophysical surveying, geochemical sampling and diamond drilling

the remainder of production coming from shrinkage stopes.

The Magino ore body is one of three ore bodies that lie within the Goudreau Lake deformation zone. Gold-bearing siliceous zones and quartz veins strike east and dip steeply to the north within sheared portions of the Webb Lake granodiorite.

Renabie Mine

In March 1991, Renabie Gold Mines Ltd. announced the planned closure of its mine near Missanabie, Ontario, effective September 1, 1991. The owners (International Corona Corporation and American Barrick Resources Corporation) indicated that the decrease in the size of the ore body, coupled with the lower grades and increasing costs of production had rendered the remaining ore reserves uneconomic (*The Northern Miner*, March 4, 1991, p.3).

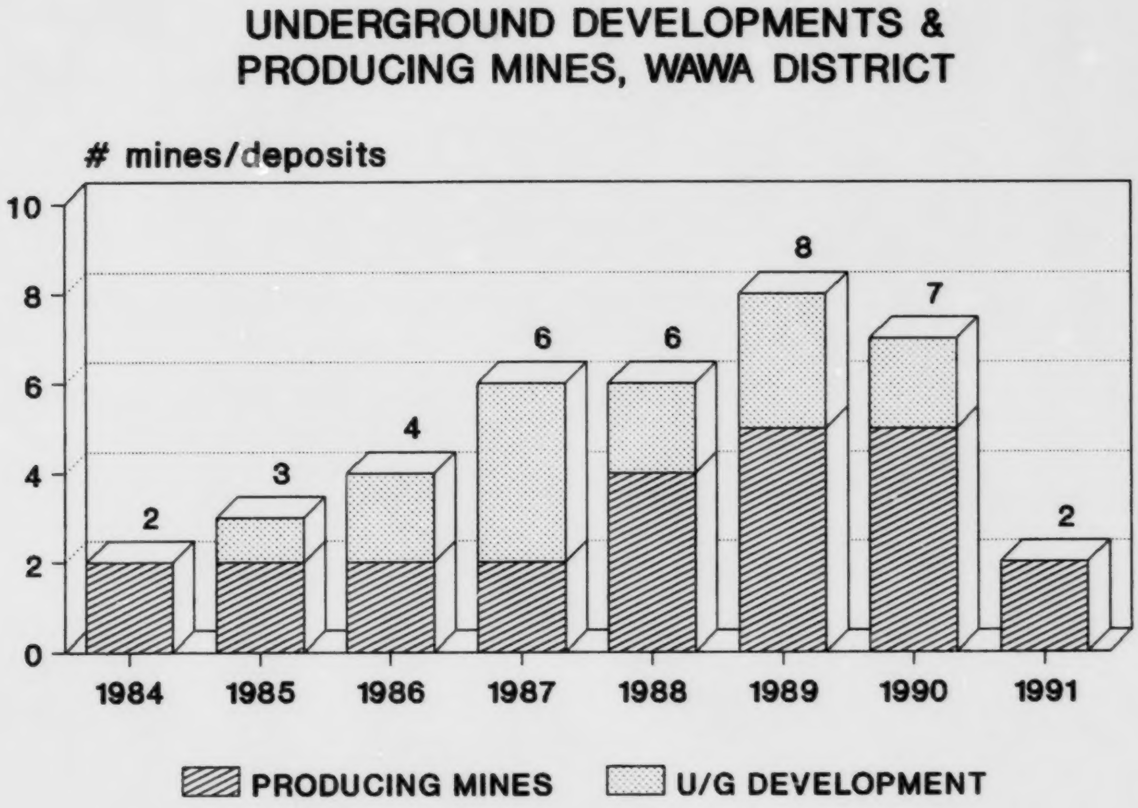
At the end of 1990, the total proven and possible reserves were 250 000 tons averaging 0.246 ounce Au per ton, with a further possible 40000 tons averaging 0.246 ounce Au per ton (*Canadian Mines Handbook 1991–92*, p.39). Diamond drilling in 1990 indicated that the everdecreasing ore body did not exist below the 4050-foot level (*The Northern Miner*, August 5, 1991, p.6).

In 1991 the mine produced 33 749 ounces of gold with an average grade of 0.299 ounces Au per ton at a 91.7% recovery. The mill operated at an average rate of 545 tons per day.

Over a lifespan that ranged from 1947 to 1991, the Renabie Mine produced 1.1 million ounces of gold (*The Northern Miner*, August 5, 1991, p.6). Production from the Renabie Mine far exceeded the total historical gold production of all of the mines in the Michipicoten greenstone belt. Total production from the Cline Lake Mine and all of the Wawa area mines combined was 263 328 ounces of gold (Sage and Heather 1991, p.75; Frey 1990, p.2).

The mine is currently undergoing closure according to the regulations of the new Mining Act that became effective in June 1991. Estimated cost for the closure of the mine is $35 million (*The Northern Miner*, August 5, 1991, p.6).

The Renabie Mine was unique in that mineralization was hosted by quartz veins and lenses within a brittle-ductile shear zone in tonalite external to the Michipicoten greenstone belt (Heather and Buck 1988).



Suspended operations, fall 1990: Kremzar, Magnacon, Lochalsh mines Source: W.R.G.O.

Figure 11.2. Producing mines and underground exploration, 1985–1991.

ADVANCED EXPLORATION AND DEVELOPMENT

Hemlo Gold Mines Inc.–Central Crude Ltd.

Following the signing of a letter of intent to purchase the Magnacon mill and assets (owned by Flanagan McAdam Resources Inc. and Muscocho Explorations Limited) in October 1990, Hemlo Gold Mines Inc. announced a decision to withdraw from negotiations for the purchase in early 1991 (*The Northern Miner*, January 7, 1991, p.12). The company had planned to use the mill to process the ore from the nearby Eagle River deposit, but made a decision to terminate negotiations based on environmental concerns.

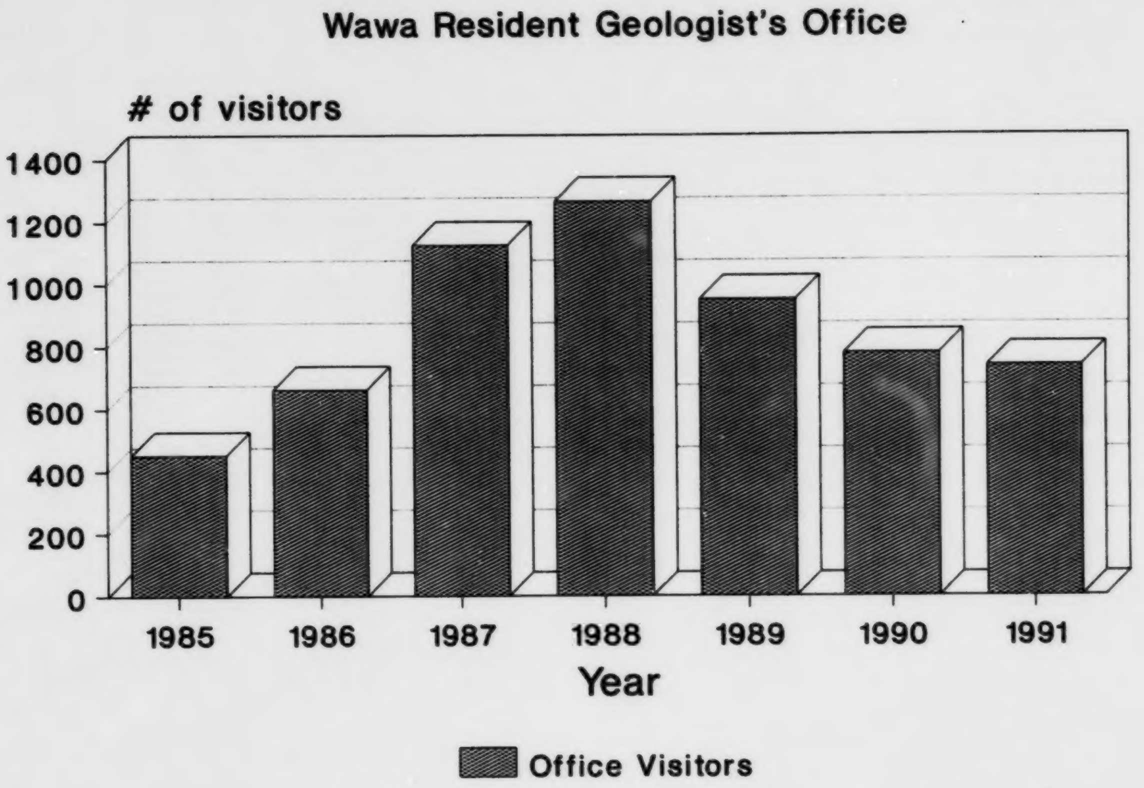
In February, Hemlo Gold Mines Inc. released a feasibility study of the Eagle River deposit and recommended that production be deferred until costs are reduced and the price of gold improves (*The Northern Miner*, February 25, 1991, p.1). Central Crude Limited has since announced its plans to bring the deposit into production (*The Northern Miner*, May 20, 1991, p.1) The company has recently signed a letter of intent to purchase 75% of the Magnacon mill (*The Northern Miner*, December 23, 1991, p.13). The Eagle River deposit hosts proven and probable reserves of 2.87 million tons averaging 0.25 ounce Au per ton, cut and fully diluted. Uncut and undiluted reserves are 2.25 million tons grading 0.48 ounce Au per ton (*The Northern Miner*, May 20, 1991, p.2). In 1989, a 3615 foot ramp and three development levels were completed underground.

EXPLORATION ACTIVITY

The location of the following exploration projects is keyed to Figure 11.1.

Anglehart, J.

J. Anglehart of Missanabie, Ontario completed a mechanical trenching program on his Copenace Township claims. Anomalous gold assay values were returned from a quartz lens and oxide facies iron formation on the property (J. Anglehart, Prospector, personal communication, 1991).



Source: W.R.G.O.
Updated: December, 1991

Figure 11.3. Client services—Wawa Resident Geologist's District.

Carroll, D.

Sault Ste. Marie prospector D. Carroll completed a program of trenching, washing and stripping on his claims on the west side of Mishibishu Lake. Anomalous gold values have been returned from quartz veins in amphibolitized mafic metavolcanic rocks (D. Carroll, Prospector, personal communication, 1991).

Clement, C.

Three drill holes were completed on the Lendrum Township property of Wawa prospector, C. Clement. Two drill holes intersected narrow bands of sulphides that contained visible gold and carried anomalous gold values (C. Clement, Prospector, personal communication, 1991).

Gold Fields (Canadian) Mining Corporation

Gold Fields (Canadian) Mining Corporation continued the program of prospecting and geochemical sampling begun in 1990 on the Ego Mine property in Abotossaway Township. A diamond-drill program will be completed on the property during the winter of 1991–92 (W. Bond, Gold Fields (Canadian) Mining Corporation, personal communication, 1991).

Lac Minerals Ltd.

A program of prospecting, geological mapping and geochemical surveying has been initiated by Lac Minerals Ltd. on a block of claims that straddles the boundary between Glasgow and Riggs townships (K. Leonard, LacMinerals Ltd., personal communication, 1991). This property lies within the Loch Lomond deformation zone (Heather and Buck 1988).

Loydex Resources Inc.

The company completed a program of mechanical stripping and trenching on its 21 claim property in eastern Riggs Township. The property is on strike with the Three–Mile Post gold occurrence that straddles the boundary between Jacobson and Riggs townships. This program was devised to investigate a series of ground geophysical anomalies. Overburden stripping uncovered a 13 foot wide, carbonatized and silicified shear zone that carried anomalous gold values up to 0.07 ounce Au per ton over 3.5 feet (L. Nelson, Loydex Resources Inc., personal communication, 1991). Loydex plans to continue their work in 1992.

Mishibishu Gold Corporation

Mishibishu Gold Corporation is drill testing three copper-lead-zinc anomalies on their Loon Lake (Homer Township) property (*The Northern Miner*, September 2, 1991, p.3).

Monk Gold and Resources Limited

During 1991, Monk Gold and Resources Limited dewatered and extended an existing ramp into the B zone on their property, 10 km south of Wawa. The program was designed to better evaluate the economic potential of the gold-bearing veins.

Gold mineralization is concentrated in shallow-dipping, northeast-trending, quartz-carbonate veins within a strongly sheared, carbonatized and silicified sericite schist. This summer's exploration program indicated that the mineralized zone is at least 20 feet wide. Assays of up to 0.89 ounce Au per ton over 1.6 feet have been returned from drill core (*The Northern Miner*, November 4, 1991, p.6). Previously, the B zone had been estimated to be 112.5 m long, 1.7 m wide and 115 m deep (*The Northern Miner*, March 20, 1989, p.17).

The Monk Gold and Resources Limited property is hosted by a regional zone of intense flattening strain, known as the Michipicoten River deformation zone, that trends 140°/90°. The deformation zone is at least 1 km wide and over 3 km long (Frey 1990).

The company is presently raising additional capital to drift along the vein system in 1992 (S. Babcock, North Superior Mineral Rsources Corporation, personal communication, 1991).

Noranda Exploration Company Ltd.

In early 1991, Noranda Exploration Company Ltd.'s affiliate, Hemlo Gold Mines Inc., signed a letter of intent with Corona Corporation Inc. to earn up to half of Corona's interest in "Operation Wawa" (*The Northern Miner*, February 4, 1991, p.3). "Operation Wawa" is a grassroots exploration project that spans 13.5 townships in the central part of the Michipicoten greenstone belt. These townships are a part of the Algoma Central Railway (A.C.R.) land grant.

The company has concentrated its activity in the Forge Lake area of Cowie Township and on the Iron Lake deformation zone in Keating and Killins townships. A program of geological mapping, geophysics, geochemical sampling and stripping was completed in the Forge Lake area where Corona Corporation Inc. had uncovered a zone of high strain. Grab samples from this high-strain zone have yielded assays as high as 0.38 ounce Au per ton (Tortosa et al. 1990). Prospecting in the Iron Lake area has outlined quartz-feldspar porphyries hosting gold-bearing quartz veins that infill fractures in the rock.

Renabie Gold Mines

Renabie Gold Mines completed a program of mechanical trenching and geochemical sampling on the Fontenac Vein and the Sinistral and Tail zones. This work was completed prior to the closure of the mine.

Spirit Lake Explorations Ltd.

A thirty-hole diamond-drill program, totalling 10 705 feet, was completed in the spring on the Edwards property in Jacobson Township. Mineralization appears to be concentrated in two high-grade, gold-bearing zones: the Porphyry and the Carbonate zones. Both of these vein systems occupy the same shear structure that controls the Magino and Lochalsh deposits.

The Porphyry Zone is the largest of the two zones. It is open below 700 feet and has produced assays greater that 1.157 ounces Au per ton over 10.9 feet. The estimated reserves of the Porphyry Zone, based on a mining width of 8 feet, are 89 800 tons, with an average grade of 0.86 ounce Au per ton (*The Northern Miner*, February 4, 1991, p.1).

The Carbonate Zone contains an estimated 66 700 tons of ore, grading 1.37 ounces Au per ton, over an average width of 7.5 feet (*The Northern Miner*, February 4, 1991, p.1). Assay values from this zone are ashigh as 1.89 ounces Au per ton.

Estimated reserves for the Porphyry and Carbonate zones are 163 100 tons of ore, grading 1.08 ounces Au per ton (*The Northern Miner*, March 11, 1991, p.19). Two additional untested targets, the Shaynee and New North horizons, lie to the east and west of the main mineralized zones (Tortosa et al. 1990).

The company is planning to obtain additional financing in order to extract a bulk sample in 1992 (D. Hendrick, Spirit Explorations Ltd., personal communication, 1991).

Van Ollie Explorations Ltd.

Van Ollie Explorations Ltd. has continued to investigate a system of gold-bearing quartz veins on their McMurray Township property. Detailed mapping has been completed on the company's Mickelson–Sunrise property and the Captain, Smith, Island and Road veins (S. Babcock, Van Ollie Explorations Ltd., personal communication, 1991). A six-hole diamond-drill program also was completed.

Preliminary results from the mapping indicate that the Smith vein dips 35° west towards the Parkhill Mine vein system. The Smith vein is interpreted to be part of that system. The Parkhill Mine (1931–40) was the largest gold producer in the Wawa area, producing a total of 54 301 ounces Au and

2816 ounces Ag from 125 778 tons of ore milled (Frey 1990). Mineralization at the Parkhill Mine was contained within a series of short, narrow quartz veins and lenses within a zone of intensely deformed felsic to intermediate tuffs and breccias.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

During the year, the Wawa office was staffed by: Resident Geologist, D. Tortosa (to the end of October 1991); Staff Geologist, A. C. Wilson; Secretary, B. Leschishin; Contract Geological Assistants, P. Beach, P. C. Delisle, R. Henri and C. Lowe. S. Southwell was hired through the Experience 1991 program to help with general office duties during the summer.

Following the termination of the four-year funding by the Northern Development Fund, all contract staff terminated their employment on March 31, 1991. A. C. Wilson was hired as Staff Geologist in August and D. Tortosa resigned from his position with the ministry in October. Administrative responsibilities have been transferred to the Sault Ste. Marie Resident Geologist. On-site geological consultations are the responsibility of the Staff Geologist and the Sault Ste. Marie Resident Geologist.

D. Tortosa was a member of the Wawa Community Adjustment Committee, the Regional Inter-Ministry Development Committee for the Wawa District and the Ministry of Northern Development and Mines Information Technology Committee. He also attended meetings of the Northern Ontario Development Agreement steering committee. D. Tortosa attended several Geographic Information Systems (GIS) courses, many in conjunction with P. Beach. He also attended the Banff Centre for Continuing Education's course on Geographic Information Systems for Integrated Resource Management in February.

D. Tortosa and P. Beach made several presentations concerning the desktop Geographic Information System (GIS) used by the Wawa office to various government and industry groups. They also presented three posters, detailing the various computer data bases developed within the Wawa office, at the annual Northeastern Region Geoscience Seminar in Kirkland Lake. A trial application of a global positioning system (GPS) was made in the Wawa area by D. Tortosa, P. Beach and P. Morra (Claims Inspector, Sault Ste. Marie Mining Recorder's office).

D. Tortosa also provided his services as translator to the South American delegation at the MINTEC conference in Sudbury in August and to a group from the Chilean Ministry of Mines visiting the province in September.

B. Leschishin provided administrative and client services to the office. On a continuing basis, she processes new assessment files submitted to the office and has been incorporating donated files into the assessment file system. Since August, she has been asssisting the Staff Geologist with the incorporation of R. P. Sage's historical assessment material into the files. An open house at the Wawa Resident Geologist's office during Mining Week was staffed by B. Leschishin, P. Beach and D. Tortosa.

Since August, A. C. Wilson has been processing the historical information collected by R. P. Sage during his ten-year mapping program in the district. This information fills a significant gap in the geological data available for many of the historical mineral occurrences in the Wawa area. Geological records and maps acquired from the closed and closing mines in the area provide a comprehensive geological resource base for the district.

A. C. Wilson, in conjunction with D. Tortosa, led a field trip and underground tour to the Magino Mine for a group of geologists visiting from the Finnish Geological Survey. The Staff Geologist also assisted K.B. Heather in preparations for his field trip to the Renabie area in October. She also conducted several local field trips for industry geologists interested in the area and gave advice to tourists interested in rock and mineral collecting locally. A poster entitled "Exploration Activities in the Wawa Area—1991" was presented at the Ontario Mines and Minerals Symposium in Toronto.

The Staff Geologist accompanied R. Huggins (Incentives Evaluator) on his visits to the properties of companies that had received OMIP funding and individuals who had received OPAP grants. She also responded to numerous requests for information from various government agencies.

While under contract in the early part of the year, A. C. Wilson completed and submitted an Open File Report for publication entitled "The Geology of the Kabinakagami Lake Greenstone Belt".

Project activities of the four contract staff members terminated at the end of March are summarized in the section entitled "Research by Resident Geologist's Staff".

PROPERTY DESCRIPTIONS

The material presented in this section has been compiled from assessment-file data and, in the case of the Mammoth Metals occurrence, field observations by the author.

Kozak Prospect–Abotossaway Township

The Kozak prospect is approximately 200 m east of Kozak Lake, in southeastern Abotossaway Township. The occurrence is accessible by a 1 km long trail from the Algoma Central Railway (A.C.R.) or by helicopter.

The property was originally staked in 1927 as a lead-zinc prospect by N. Kozak. Erratic yet unexpectantly high values in gold and silver prompted the owners to option the property for its precious metals potential. Following sporadic surface exploration by Kozak Gold Mines, Orecana Mines Limited sank a two-compartment shaft to 110 feet and established two levels, at 35 and 100 feet, in 1934. No ore bodies were defined on the property and the property was abandoned.

The property lay dormant from 1934 until 1962 when Adonis Mines Limited completed 68 diamond-drill holes (12 462 feet total). Nine westward-dipping, potential gold-bearing zones were outlined which ranged in length from 20 to 266 feet. Potential reserves from the mineralized zones were estimated to be 31 054 tons with an average grade of 0.77 ounce Au per ton and 4.24 ounces Ag per ton (assessment files, Resident Geologist's office, Wawa).

The property has remained inactive since Golden Spoke Mines Inc. completed a program of ground geophysics, geological mapping, soil geochemistry and diamond drilling in 1981 (assessment files, Resident Geologist's office, Wawa).

Mineralization occurs in a series of parallel quartz-carbonate veins that are confined to a zone of strongly sheared and heavily carbonatized (ankerite) intermediate to felsic metavolcanic rocks. Sage (1985a) reported scattered chloritoid grains in the rocks southwest of the shaft. Narrow diabase dikes crosscut the stratigraphy at 030° and 340°.

Quartz veins are prominent on the Kozak prospect. They vary in width from less than 1 foot to 8 feet and are of variable strike length. The highest assays (0.25 ounce Au per ton, 11.2 ounces Ag per ton over 2.9 ft.) have been obtained from the shaft vein and occur where massive, barren quartz enclosed in carbonate is crosscut by sugary quartz stringers. The mineralization consists of galena, chalcopyrite, pyrite and sphalerite as irregular patches and fine disseminations throughout the carbonate altered zones. Native gold and silver also have been reported (assessment files, Resident Geologist's office, Wawa).

Surface drilling has yielded significant assays on the property. Values of 0.052 ounce Au per ton and 3.64 ounces Ag per ton over 4.3 feet and 0.30 ounce Au per ton and 18.54 ounces Ag per ton over 2.3 feet have been reported. A sample of the wall rock on the 35 foot level yielded an assay of 0.13 ounce Au per ton, 3.63 ounces Ag per ton and 1.11% Zn. A sample of the wall rock on the 100 foot level assayed 0.34 ounce Au per ton, 3.78 ounces Ag per ton, 0.25% Pb and 0.90% Zn (assessment files, Resident Geologist's office, Wawa).

The local foliation trends approximately 265°/76°N and a shear zone transects the area at approximately 080°/90° (Sage 1985b). Ankerite-sericite-chlorite alteration zones are associated with both the shear zone and the north-trending fractures in the area.

The Kozak prospect may lie within the southwest extension of the Cradle Lakes deformation zone. Features described on the property display a strong similarity to the features described in the deformation zone. The deformation appears to be brittle fracture and a high degree of alteration (both carbonate and sericite) is confined to the high strain zone. The deformation appears to be close to the contact between intermediate to felsic metavolcanic rocks and mafic to intermediate metavolcanic rocks. The property and the adjacent area within the deformation zone warrant reconsideration as a base-metal prospect (Arias and Heather 1987).

Mammoth Metals Occurrence—Chabanel Township

The Mammoth Metals occurrence, also known as the Christie showing or the O'Keefe vein, is approximately 500 m north of Wawa Lake in the southeastern corner of Chabanel Township. Access to the property is by boat from Wawa and a short traverse along a trail to Mammoth Lake.

The property has remained unexplored since 1929 when Mammoth Metals Ltd. sank an inclined shaft to a depth of 65 feet to examine the lead mineralization. One hundred and sixty-five feet of drifting are reported to have been completed to the southwest and 15 feet of drifting to the west-northwest. A bulk sample of unknown size was shipped from an open pit on the property (assessment files, Resident Geologist's office, Wawa). A second shaft of unknown depth and vintage also has been discovered on the site.

Mineralization is associated with the contact between a diorite to quartz gabbro to the north and intermediate to felsic tuffs and lapilli tuffs to the south. The metavolcanic rocks and the intrusive contact are strongly sheared and carbonatized while the diorite immediately to the north is massive and fresh in appearance. Chloritoid has been observed in the metavolcanic rocks to the south of the occurrence (Sage, et al. 1982a).

Galena, sphalerite and arsenopyrite have been observed in three veins on the property. The main occurrence, where all of the exploration has been concentrated, is the Christie vein. It is a narrow width (8 inch to 22 inch), highly contorted quartz vein that is traceable for 600 feet. The quartz vein strikes northeast and dips flatly to the north (085°/40°N). Arsenopyrite constitutes approximately 10% to 20% of the vein material. Galena and sphalerite are locally important in other sections of the vein. The wall rock surrounding the vein is moderately to intensely sheared and contains minor disseminations of quartz and arsenopyrite outside of the vein (assessment files, Resident Geologist's office, Wawa).

The O'Keefe vein, which lies 1000 feet north of the Christie vein, has not been thoroughly explored. Mineralization occurs in multiply folded quartz stringers and veinlets that dip flatly to the north. Galena and sphalerite are present in minor amounts in the quartz veins. These veins occur in sheared intermediate to felsic metavolcanic rocks and appear to be an on-strike extension of the veins that compose the Johnson showing, northeast of the Mammoth Metals occurrence (assessment files, Resident Geologist's office, Wawa).

A rusty, carbonatized shear zone has been observed in the intermediate to felsic metavolcanic rocks on the trail between the shaft and Wawa Lake. This shear zone trends slightly north of east and contains several narrow, barren quartz stringers (assessment files, Resident Geologist's office, Wawa).

Assays from samples taken from the test pit on the Christie vein in 1928 are reported to be as high as 36.80 ounces Ag per ton, 41.1% Pb and 2.96% Zn over 11 inches and 59.24 ounces Ag per ton, 72.41% Pb and 0.58% Zn over 11 inches. Gold values are trace to nil. Grab samples taken from a muck pile in 1967 yielded up to 63.26 ounces Ag per ton (assessment files, Resident Geologist's office, Wawa).

Regnery Molybdenite Occurrence—Esquega Township

The Regnery molybdenite occurrence is in north central Esquega Township, approximately 2.5 km west-southwest of the town of Hawk Junction. The property is accessible by bush road from Hawk Junction.

Following the discovery of molybdenum on the property in 1932, Regnery Metals sank a 300 foot, three-compartment shaft and developed two mining levels. The shaft was dewatered in 1958 when the property was taken over by International Ranwick Ltd. A program of underground sampling and combined surface and underground diamond drilling was completed by the company in 1958 (assessment files, Resident Geologist's office, Wawa). The property has remained dormant since that time.

The Regnery molybdenite occurrence lies close to the western contact between the Hawk Lake granodiorite and a younger quartz-feldspar porphyry (Sage et al. 1982b). The granodiorite is coarse grained and highly fractured. These fractures often contain quartz-carbonate veins that are molybdenum bearing. Quartz-feldspar porphyry and diorite appear to intrude the granodiorite as dikes, although absolute relationships are difficult to establish. Lamprophyre dikes, or strongly sheared, scattered, mafic metavolcanic enclaves, trend northeast across the property. High molybdenite values are associated with these lamprophyres or mafic enclaves. A 20 to 40 foot wide diabase dike crosscuts the stratigraphy (assessment files, Resident Geologist's office, Wawa).

Four mineralized zones have been outlined underground. These zones consist of two ages of quartz-filled fractures within the granodiorite. Chlorite and biotite are frequently associated with the quartz. These zones range from 40 to 130 feet in length and are 6 to 40 feet wide (assessment files, Resident Geologist's office, Wawa).

Mineralization is reported to consist of finely disseminated molybdenum and chalcopyrite. Pyrite and sphalerite are rare. The Regnery deposit generated considerable interest because of reported anomalous beryllium assays. No mineralogical source for the beryllium was ever discovered (assessment files, Resident Geologist's office, Wawa).

The results of a 400 ton mill sample, processed prior to 1940, yielded a concentrate with 65% to 70% MoS_2 and 2% Cu. This concentration was reportedly improved to 82% MoS_2 and the copper values reduced to 0.38% Cu before operations ceased. Two separate reserve estimations on the four mineralized zones were: 92 795 tons at 0.902% MoS_2 (undiluted) and 146 966 tons at 1.09% MoS_2 (assessment files, Resident Geologist's office, Wawa).

Crane Deposit—Franchere Township

The Crane deposit, or the Michipicoten tungsten occurrence, is approximately 7.2 km east of the mouth of the Univeristy River on the shore of Lake Superior (Bennett and Thurston 1977). Access to the property is by boat from Wawa, a distance of 18.3 km, or by helicopter.

Scheelite was discovered on the property prior to 1943 by Hollinger Consolidated Gold Mines. Algoma Ore Properties conducted a detailed mapping project on the property in 1943. No additional work has been done since 1952 when the Crane Co. completed trenching, mapping and 2241.7 feet of diamond drilling (assessment files, Resident Geologist's office, Wawa).

The scheelite- and molybdenite-bearing quartz veins are contained within a zone of highly deformed conglomerate that, in turn, is enclosed in trondhjemite (Bennett and Thurston 1977). The conglomerate has been reported to contain well-rounded clasts of granodiorite and schist and appears to be comparable to the Dore-type conglomerate that outcrops in the western part of the Michipicoten greenstone belt. The conglomerate has undergone extensive metamorphism to a biotite- and hornblende-bearing schist containing relict clasts. The surrounding trondhjemite is massive but becomes progressively more foliated at the margins of the conglomerate. East-trending diabase dikes crosscut the regional geology. The regional foliation trends approximately northwest and dips very steeply to the west at the western contact and changes to approximately 073° east at the eastern contact (Harley 1985).

Three scheelite-bearing zones have been identified. They are distributed linearly and are conformable with the overall regional foliation. Bennett and Thurston (1977) describe the main zone as being approximately 9 m wide and extending to the northwest for approximately 400 m. These mineralized zones consist of scheelite- and molybdenum-bearing quartz veins or quartz septa in the schist (assessment files, Resident Geologist's office, Wawa).

The northern zone is approximately 600 feet long and consists of several scheelite-bearing quartz veins. The scheelite is erratically distributed. An intermediate zone consisting of quartz veins and lenses occurs at the contact between the schist and the trondhjemite. This zone is approximately 400 feet long and 3.5 feet wide. Again, scheelite is sparsely distributed. The southern zone is the only zone that has undergone extensive diamond-drill testing. It consists of a 30 foot wide zone containing individual quartz veins that are up to 25 feet wide (assessment files, Resident Geologist's office, Wawa).

Scheelite is erratically distributed within the vein system. Usually it occurs as grains, crystals and veinlets that reportedly range up to several inches in width and several feet in length (assessment files, Resident Geologist's office, Wawa). The scheelite is most commonly present along schist septa enclosed in quartz veins or at the margins of quartz veins. It also has been observed enclosed entirely within quartz veins or as isolated grains within the schist. No scheelite has been observed at a distance greater than three feet from the quartz veins (assessment files, Resident Geologist's office, Wawa).

Minor molybdenite occurs as fine-grained crystals within the schist septa or within quartz veins. Pyrite is mainly associated with the scheelite (assessment files, Resident Geologist's office, Wawa).

Assays from the 1952 drilling program average 0.19% WO_3 across 29.6 feet. Two concentrate tests performed on the occurrence indicate that the scheelite content of the southern zone is 0.35% WO_3 per ton of rock. Drilling has indicated potential reserves of 66000 tons, grading 3.0 lb WO_3 per ton have been estimated (assessment files, Resident Geologist's office, Wawa). A second tungsten-molybdenum showing (the Fenlon scheelite occurrence) is approximately 2 km northeast of the Crane deposit. Scheelite has been observed in four locations within a 10 foot wide by 200 foot long zone of vein quartz and schist septa. Assay results from channel samples in the quartz vein range up to 0.54% WO_3 over five feet. The schist enclosed in the quartz returned noticeably lower values of less than 0.09% WO_3 over three feet. This occurrence has undergone no exploration since 1943 (assessment files, Resident Geologist's office, Wawa).

RESEARCH BY RESIDENT GEOLOGIST'S STAFF

This section outlines the results of all projects funded by the Northern Development Fund that terminated March 31, 1991

Two programs were initiated through this funding. The first program consisted of several separate projects that were completed in 1991 and which are outlined below. The second program involved the incorporation of Algoma Central Railway assessment file information into the files at the Resident Geologist's office (completed 1990) and the development of a data base of applicable work permits and acts involved in the mining sequence (completed 1989). A project to evaluate the Wawa district for industrial mineral potential also was completed prior to 1991 (Tortosa et al. 1990, p.187).

A summary of the remaining projects is presented below.

Computer Applications (Desktop Geographic Information System)

The results of this project are:

1. the development of a series of township maps for areas of high mineral potential at a scale of 1:20000
2. the compilation of all geochemical data for the Wawa area as text, cross referenced to topographic maps
3. a comprehensive digital data set accessible with desktop GIS software
4. the development of a series of base maps providing information concerning sources of potential land use conflict

This project was conducted by R. Henri and P. Beach in the Sault Ste Marie office.

Compilation and Organization of Mineral Resource Information

This project involved the compilation and updating of Geological Data Inventory Folios (GDIFs) for areas of high mineral potential in the area. C. Lowe completed and submitted 10 GDIFs for publication in April 1991 (*see* "Selected Publications Received" section, this report).

The results of this project are:

1. ten new GDIFs were compiled for the Mishibishu Lake greenstone belt
2. four GDIFs compiled prior to 1987 were updated
3. a computer data base has been established to permit rapid and convenient updates of current GDIFs

Evaluation of Mineral Resources, Granitic and Gneissic Terrains

This project was completed by A. C. Wilson and resulted in the publication of an Open File Report in 1990 (Tortosa et al. 1990, p. 187) and the submission of a second Open File Report in 1991. A publication date for the second report titled "The Geology of the Kabinakagami Lake Greenstone Belt", has yet to be announced.

Development of a Computerized Mineral Deposits Data Base

This program was developed and completed by E.D. Frey and R.C. Stewart (Tortosa et al. 1990, p. 191). An Open File Report was completed and submitted in January 1991.

The results of this project are:

1. compilation of geological information on 409 mineral occurrences in the Wawa area (Wawa Mineral Deposits Data Base)
2. design of a simple and easily updated data base
3. development of a simple computer program to search and print selected data
4. a transfer of this material has been made to the provincial Mineral Deposits Inventory (MDI) portion of the Geoscience Exploration Data Base (GED)

Mineral Occurrence Investigations in Esquega Township

P.C. Delisle completed a contribution to the metallogeny of the Michipicoten greenstone belt in 1991. An Open File Report titled "Mineral Occurrence Investigations in Esquega and Corbiere Townships, Wawa District" was published in September 1991.

The results of this project are:

1. sixteen mineral occurrences in the Wawa–Hawk Junction area were mapped in detail
2. additional lithogeochemical data has been acquired to supplement that of R.P. Sage
3. new mineralized zones have been identified

RECOMMENDATIONS FOR EXPLORATION

Base Metals

Base-metal prospects and gold prospects containing anomalous base-metal values occur within the komatiitic and intermediate to felsic metavolcanic flows of the lower volcanic cycle of the Michipicoten greenstone belt (Figure 11.4). Of the 105 known mineral occurrences in the district with major commodities other than gold or iron, eleven (10%) occur in Esquega Township. Less than 50% of Esquega Township is underlain by the rocks of the lower volcanic cycle (Sage et al. 1987). No systematic prospecting of these base-metal prospects has ever been attempted nor have they ever been assessed as guides to other discoveries.

The presence of several large, barren (free of gold) sulphide deposits in the greenstone belt indicates that the area is favourable for sulphide deposition. The problem remains to identify zones of base-metal concentration.

The mineral occurrences in Esquega Township display a broad range of minerals, including sphalerite, galena, chalcopyrite, pyrrhotite and arsenopyrite. Coupled with an even more complex array of elements, such as mercury, bismuth and beryllium, it appears that one or more complicated hydothermal systems was active within the lower volcanic cycle. These hydrothermal systems may have been associated with the emplacement of the quartz-feldspar porphyry intrusions and extensive fracturing that are prominent within Esquega Township.

Detailed prospecting and sampling of many of the base-metal prospects, such as the Mammoth Metals occurrence or the molybdenite showings in Esquega and Lastheels townships, are warranted in order to better understand the complexity of the base-metals mineralization and distribution. A systematic assessment of the mafic-felsic transition of all four of the volcanic cycles in the Michipicoten greenstone belt may result in the discovery of new base-metal occurrences.

These known stratigraphic associations, if combined with the recent regional airborne magnetic and electromagnetic surveys for the greenstone belt may prove to be an effective prospecting tool.

Gold

Historically, extensive gold prospecting has occurred on the north limb of the Goudreau anticline or within the Goudreau Lake deformation zone. Very little attention has been paid to the south limb of the anticline, particularly in Aguonie and Bird townships. Several gold occurrences lie along a magnetic high that trends northeast along the contact between the felsic to intermediate metavolcanic rocks and mafic to intermediate rocks. The Kozak prospect is one of these occurrences (*see* Figure 11.5).

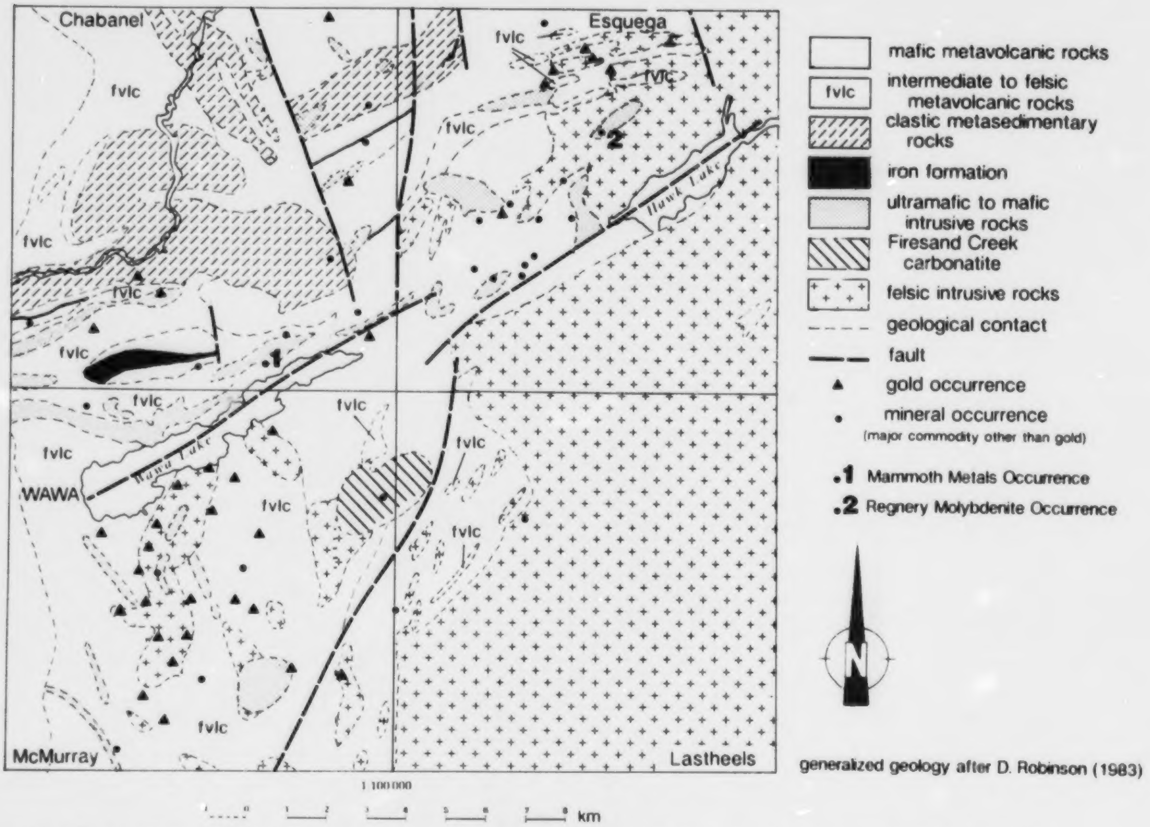
A magnetic high expressed on the Ontario Geological Survey airborne geophysical maps (OGS 1987) is coincident with the Cradle Lakes deformation zone described by Arias and Heather (1987). This zone is 1 to 2 km wide and has been documented to be at least 5 km long.

Many similarites exist between the Cradle Lakes and the Goudreau Lake deformation zones which would indicate the economic potential for this zone. Arias and Heather (1987) did not observe quartz veins in the section of the deformation zone they examined. However, at the Kozak prospect, significant mineralization does occur in a series of parallel quartz-carbonate veins. Further investigation of the Cradle Lakes deformation zone and the entire south limb of the Goudreau anticline is suggested to evaluate their potential.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

Precambrian Geology Section

R.P. Sage, in co-operation with the Wawa Resident Geologist, conducted the tenth annual spring field trip in the Wawa area. This year the field trip concentrated on property visits in the Goudreau–Lochalsh, Mishibishu Lake and Renabie Mine areas.


Chabanel
Esquega
Lastheels
McMurray
WAWA
Wawa Lake
Hawk Lake
fvlc
1
2
mafic metavolcanic rocks
fvlc intermediate to felsic metavolcanic rocks
clastic metasedimentary rocks
iron formation
ultramafic to mafic intrusive rocks
Firesand Creek carbonatite
felsic intrusive rocks
geological contact
fault
gold occurrence
mineral occurrence (major commodity other than gold)
•1 Mammoth Metals Occurrence
•2 Regnery Molybdenite Occurrence
N
1:100 000
km

generalized geology after D. Robinson (1983)

Figure 11.4. Distribution of mineral occurrences related to rock type in Chabanel, Esquega, Lastheels and McMurray townships.

K. B. Heather, in conjunction with the Wawa Staff Geologist, led a fall field trip on request for a group of industry participants to examine properties in the Goudreau–Lochalsh and Renabie Mine areas.

Although the attendance on these field trips has substantially decreased from the participation in 1988–89, they still remain a popular introduction to the geology of the Michipicoten greenstone belt for industry geologists.

Quaternary Geology Section

T.F. Morris completed the 1:50 000 scale Quaternary mapping of the north half of the Manitowik Lake (NTS 42C/1) and the south half of the Franz (NTS 42C/8) map sheets. This field program was the continuation of the mapping he completed in 1990 (Morris 1990).

This mapping, and particularly the regional till sampling program that accompanied it, will provide a valuable tool for prospectors and companies conducting mineral exploration in the Wawa district. The preliminary map from the 1990 field season is expected to be released in early 1992.

Geophysics-Geochemistry Section

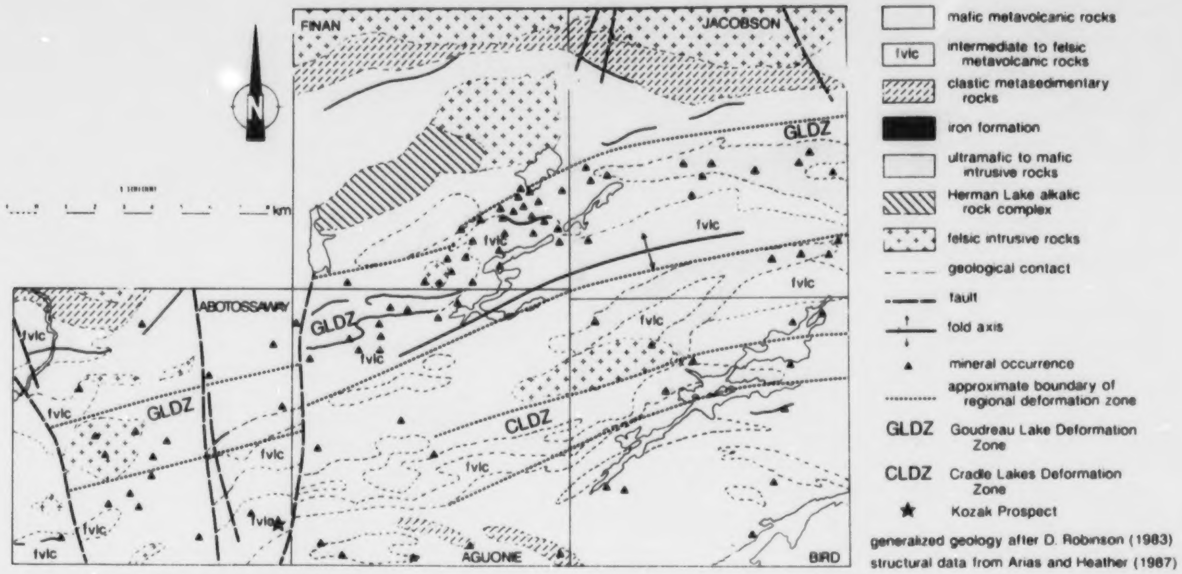
J.A.C. Fortescue, E.A. Vida and D.R. Wadge conducted a lake sediment sampling survey in the Murray Lake area, Bryure and Copenace townships, in September and October 1991. This survey consisted of short lake-sediment core samples taken at a sample density of approximately one sample per square kilometre.

The field work conducted this year completes a survey initiated in 1989 (Fortescue et al. 1989). The release of this information, combined with a similar release in 1990 for the Herman Lake area, will provide explorationists with a broad range of geochemical information pertinent to mineral exploration in the north-central portion of the Michipicoten greenstone belt (OGS 1990).

RESEARCH BY OTHER AGENCIES

R. Rice (Assistant Professor, Carleton University) completed the second year of a three-year investigation of the sedimentary evolution of the Archean Dore-type metasedimentary rocks. This study is examining the relationship between the sedimentary evolution and the economic mineralization in the area.

R. Rice also has been working in conjunction with C. Shrady (Assistant Professor, St. Lawrence University, New


FINAN
JACOBSON
ABOTOSSAWAY
AGUONIE
BIRD
GLDZ
CLDZ
fvlc
N
km
mafic metavolcanic rocks
fvlc intermediate to felsic metavolcanic rocks
clastic metasedimentary rocks
iron formation
ultramafic to mafic intrusive rocks
Herman Lake alkalic rock complex
felsic intrusive rocks
geological contact
fault
fold axis
mineral occurrence
approximate boundary of regional deformation zone
GLDZ Goudreau Lake Deformation Zone
CLDZ Cradle Lakes Deformation Zone
Kozak Prospect

generalized geology after D. Robinson (1983)
structural data from Arias and Heather (1987)

Figure 11.5. Regional geology, deformation zones and mineral occurrences in the Goudreau-Lochalsh area.

York) and Z. Arias (MSc candidate, Queen's University) to integrate their field work into a synoptic study.

ACKNOWLEDGMENTS

The author would like to thank G. Bennett and J.W. Newsome for their editorial comments on the manuscript. All contributions from informed sources working in the area are gratefully acknowledged.

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12. Sault Ste. Marie Resident Geologist's District—1991

G. Bennett[1], E.J. Leahy[2] and J. Walmsley[3]

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INTRODUCTION

The announced closure of the Denison Mine was the expected result of the large inventories of uranium fuel coupled with a low market demand (see subheading "Denison Mines Limited" further on).

With the resignation of D. Tortosa as Resident Geologist for the Wawa Resident Geologist's District, the administration of the district returned to the Sault Ste. Marie Resident Geologist's office. Services at the Wawa office will continue to be provided by A. Wilson, Staff Geologist, and B. Leschishin, Secretary (*see* A. Wilson, this volume).

From January, 1991, until his retirement in November, 1991, J.A. (Jim) Robertson served as Mineral Development Consultant at the recently opened Elliot Lake office. During his career with the government of Ontario, Jim spent many productive years as a field geologist, a manager, and a uranium-commodities specialist.

As of December, 1991, the Elliot Lake Geology office of the Ontario Ministry of Northern Development and Mines, Mines and Minerals Division, is staffed by M. Hailstone who was formerly Staff Geologist at the Kenora Resident Geologist's office.

MINING ACTIVITY

Denison Mines Limited

Denison Mines Limited operates the Denison Mine at Elliot Lake. In April, 1991, Denison announced that it will be unable to supply uranium at the lower price requested by Ontario Hydro under the terms of an agreement signed in 1977. Soon afterwards, Denison announced the closure of its Elliot Lake operations effective April 30, 1992. The closure of the Denison Mine will result in the loss of about 1050 jobs in the town of Elliot Lake (*The Sault Star*, May 9, 1991; *The Elliot Lake Standard*, May 1, 1991; Resident Geologist's files.).

Between January 1, 1991, and December 30, 1991, it is estimated that the Denison Mine had produced 27 800 000 pounds of U_3O_8 from 1 166 380 tons of ore with a grade of 1.92 pounds U_3O_8 per ton.

The last phase of the contract calls for the production of 2 750 000 pounds of U_3O_8 to be delivered to Ontario Hydro by May 1, 1992. A special production-incentive plan is in place which will allow an earlier closure of the mine prior to May 1, 1992, if the production commitments are met (A. MacKechern, Denison Mine Limited, personal communication, December, 1991).

Since the time production began in 1957, the estimated total shipments of uranium by the projected closure date of the mine will be 147 300 000 pounds of U_3O_8 from 69.5 million tons of ore averaging 2.25 pounds of U_3O_8 per ton. The Denison Mine is large by any standard, but a more tangible realization of the scale of the Denison operations over the years is indicated by visualizing the volume of the open workings in terms of a tunnel of equivalent volume. When the formula is applied to the Denison Mine workings, an equivalent tunnel (approximately 10 by 14 feet) would be 1090 miles (1750 km) long (A. MacKeachern, Denison Mines Limited, personal communication, December, 1991).

Rio Algom Mines Limited

STANLEIGH MINE

Rio Algom Mines Limited has a contract to supply uranium to Ontario Hydro until 1996; it operates the Stanleigh Mine at Elliot Lake. The renegotiation of this contract in 1991 called for an increased output from the Stanleigh Mine from 1.2 to 1.8 million tons annually effective January 1, 1992.

The third- and fourth-quarter efforts for 1991 were aimed at increasing production gradually through the addition of staff and the acquisition of additional equipment. The main thrust of present development is eastward along all levels between 3000 and 3600 feet elevation. About one quarter of the production is from development occurring westward towards the common boundary with the Geomaque (formerly Silvermaque) property. Development is principally from the main-reef horizon, with secondary development coming from the upper reef and minor development from the lower reef. Bacterial leaching accounts for about 6% of current production.

Ontario Trap Rock Ltd.

In the fall of 1990, a newly formed company called Ontario Trap Rock Ltd. trucked 120 tons of Nipissing diabase (trap

Table 12.1. Exploration activity in the Sault Ste. Marie Resident Geologist's District.

Abbreviations

AEM	Airborne electromagnetic survey
Mag.	Magnetometer survey
EM	Electromagnetic survey
VLF	Very low frequency
Rad	Radiometric survey

Company/Individual (Property Name)	Township (Commodity)	Exploration Activity
1. Allen Explorations Limited	Guindon Twp.	prospecting
2. Bell, M.	Sherratt Twp.	VLF-EM, Mag.
3. Blue Heaven Res. Corp.	Kincaid Twp.	VLF-EM, drilling
4. Doran, F.	Palmer Twp. (Au)	stripping, sampling
5. Doran, F., Korab, J., MacDougall, D., Palumbo, J.	Kincaid Twp. (Cu)	prospecting, sampling, line cutting
6. Doran, F., MacDougall, D. Korab, J.	Ryan Twp. (stone)	prospecting
7. Fleming, D., Desjardins, Y. (Cooper Showing)	Hughes Twp. (Cu, Pb, Zn)	line cutting, prospecting, stripping, trenching
8. Goodmurphy, E., Murphy, I	Norberg Twp. (Au)	prospecting, sampling, assaying
9. Goodmurphy, E., Murphy, I	Olsen Twp. (Au)	RAD
10. Haugeneder, J. Fleming, D., Richards, W.	Chesley Twp. (Cu, Au)	road construction, diamond drilling
11. Julien, P.E.	Casson Twp. (Cu)	line cutting, VLF-EM trenching, prospecting
12. McLean, P.	Daumont Twp. (Cu, Au)	mapping, prospecting, self-potential survey
13. Noranda Ex. Co. Ltd.	Ryan Twp. (Cu, Au)	sampling, Au, Cu, geological mapping
14. Noranda Ex. Co. Ltd. (Glenrock Prospect)	Palmer twp. (Au)	trenching line cutting,
15. Pellerin, U. (Footprint Lake Showings)	Gould Twp. (Cu)	VLF-EM, prospecting
16. Placer Dome Ex. Ltd.	Loach Twp.	geological mapping
17. Tims, A.	Hembruff Twp.	line cutting, sampling
18. Tri-Origin Ex Ltd	Runnalls Twp. (Au)	sampling

rock) from Bruce Mines to a potential customer in southern Ontario for batch testing. The success of this testing led to contract agreements. On May 11, 1991, the first shipment of over 12000 tons, loaded on the carrier "Algoma Canyon", left for southern Ontario. By early November of 1991, a second shipment had been made. This trap rock is used to produce rock wool insulating material for industrial use.

This new trap-rock producer has energetically pushed ahead with various physical, chemical and marketing studies and is just entering the field of potential new uses and customers for their various-sized quarry products. These uses include breakwater stone, or riprap; high-strength, heat-resistant concrete; railway ballast; specialized filter-bed stone; road-building aggregates and high-wear-resistant asphalt stone.

At present, most of the blasting, crushing, sizing, and transportation work undertaken at the quarry is contracted out to to local individuals. Investors in the company include both Canadian and American interests. J. Bourque of Sault Ste. Marie, Michigan, is president of Ontario Trap Rock Ltd.

Root River Sandstone Quarry

This quarry, located beside Highway 17 North in the city of Sault Ste. Marie, continued to produce red Jacobsville

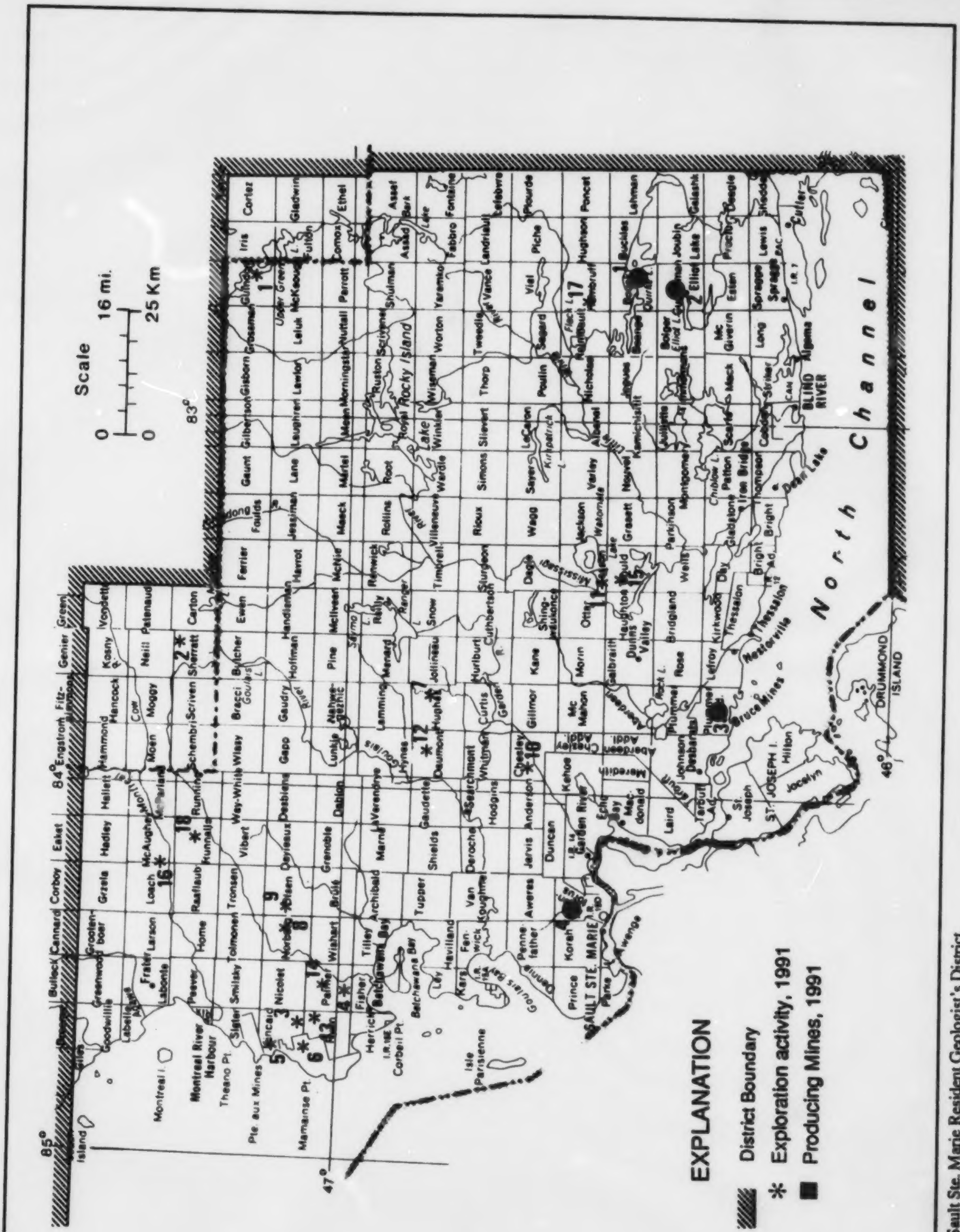
Scale
0 16 mi.
0 25 Km
83°
84°
85°
47°
46°
Montreal I.
Montreal River Harbour
Theano Pt.
Pte. aux Mines
Mamainse Pt.
Corbeil Pt.
Batchawana Bay
Isle Parisienne
Goulais Bay
SAULT STE. MARIE
Echo Bay
St. Joseph
ST. JOSEPH I.
Bruce Mines
Thessalon
Rocky Island Lake
BLIND RIVER
DRUMMOND ISLAND
North Channel
EXPLANATION
District Boundary
Exploration activity, 1991
Producing Mines, 1991

Figure 12.1. Sault Ste. Marie Resident Geologist's District.

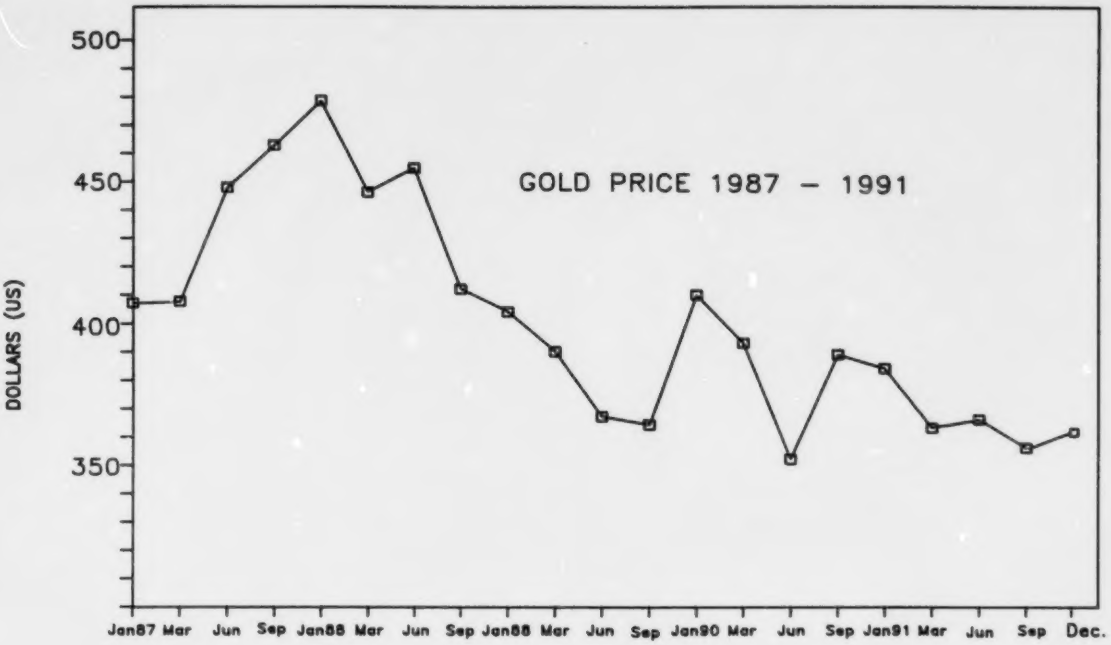

Figure 12.2. The average gold price, in US$, from 1987 to 1991.

Formation Sandstone on demand for flagstone and decorative uses; E. Koseba is the operator.

EXPLORATION ACTIVITY

Mineral exploration activity in the Sault Ste. Marie Resident Geologist's District (Table 12.1, Figure 12.1) was roughly equivalent to that of 1990, however, the total number of mining claims recorded in 1991 was only 909 (claim units) compared to 2556 claims recorded for the previous year.

The recent trend in metal prices (Figures 12.2 and 12.3), coupled with the general state of the North American economy, was reflected in the reduced level of mineral exploration activity in the Sault Ste. Marie Resident Geologist's District.

As in 1990, most projects were those of local prospectors who were partly financed by the Ontario Prospectors Assistance Program (OPAP).

There were 23 OPAP grants awarded for the Sault Ste. Marie Resident Geologist's District—total funding was $211 120. Three companies received Ontario Mineral Incentive Program (OMIP) grants totalling $148 077.

Allen Explorations Limited

Allen Explorations Limited of Wahnapitae, Ontario, holds 1 claim near White Owl Lake in Guindon Township. Prospecting was conducted over the claim in 1991 (S. Allen, Prospector, Allen Explorations Limited, personal communication, 1991).

Bell, M.

M. Bell holds 19 unsurveyed claims in northern Sherratt Township. In May, 1991, 14.8 km of grid lines and 3 km of base line were cut. A very low frequency electromagnetic (VLF-EM) survey was conducted over 10.7 km of line, and a magnetometer survey was done over 14 km of line (*Report of Work Conducted* form, Sault Ste. Marie Mining Recorder's office).

Blue Heaven Resources Corporation

Blue Heaven Resources Corporation holds 20 unsurveyed claims in Kincaid Township on the southern shore of Pancake Lake. The claims enclose an airborne-survey-detected electromagnetic anomaly under Pancake Lake which is shown on Ontario Geological Survey map 81456 (OGS 1990).

During the summer of 1991, the airborne survey's anomaly was verified by a ground VLF-EM survey conducted over the lake (by boat). A diamond-drilling program was performed in October and November from a drill setup near the southern shore of Pancake Lake (G. Babcock, Blue Heaven Resources Corporation, personal communication, 1991).

Doran, F.

F. Doran holds 4 unsurveyed claims in south-central Palmer Township. Hand stripping and rock sampling of a quartz vein

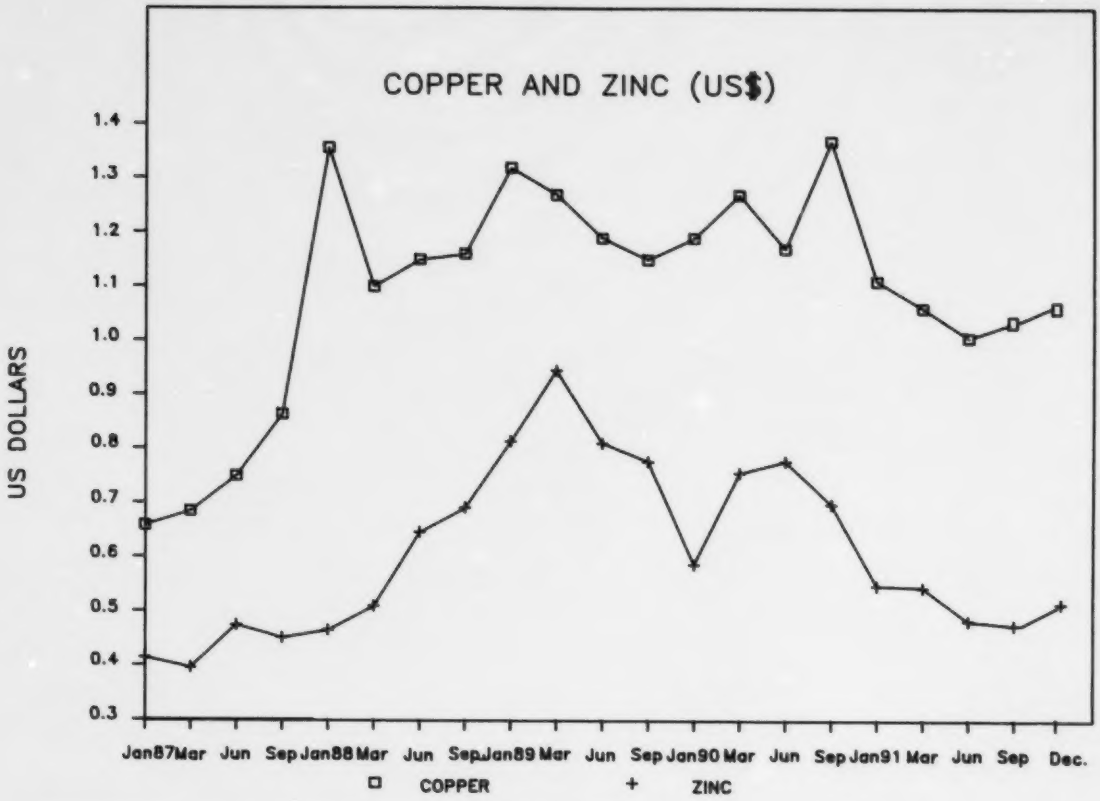

Figure 12.3. The average price of copper and zinc, in US$, from 1987 to 1991.

on the property in the search for gold was completed in 1991. F. Doran also did reconnaissance prospecting over other parts of Palmer Township (F. Doran, Prospector, personal communication, 1991).

Doran–Korab–MacDougall–Palumbo

Sault Ste. Marie area prospectors, F. Doran, J. Korab, D. MacDougall and J. Palumbo hold 6 contiguous, unsurveyed claims in Lots 7 and 8 of Kincaid Township and the McDonnell Mining Location. The claims enclose a north-striking fault zone with chalcopyrite, bornite, malachite, chalcocite and native copper (Bennett et al. 1990). Additional prospecting, sampling and line cutting was carried out on the prospect in 1991 with the financial assistance of the Ontario Prospectors Assistance Program (OPAP) (F. Doran, Prospector, personal communication, 1991).

Doran–MacDougall–Korab

F. Doran, D. MacDougall and J. Korab hold 1 claim each of a contiguous block of claims in Ryan Township. The claims enclose an area of "daisy stone", a cumulophyric (glomeroporphyritic) basalt of Keweenawan age. Prospecting and stripping was done on the property in 1991 (F. Doran, Prospector, personal communication, 1991).

Fleming–Desjardins

Prospectors, D. Fleming and Y. Desjardins, hold 5 unsurveyed claims (8 claim units) in Hughes Township. During the 1991 field season, the pair did some line cutting, prospecting, as well as stripping and trenching on 3 areas. D. Fleming and Y. Desjardins were the recipients of OPAP grants (D. Fleming, Prospector, personal communication, 1991).

Goodmurphy–Murphy

In the summer and fall of 1991, E. Goodmurphy and I. Murphy completed prospecting, outcrop sampling and assaying over a 26 claim group in east-central Norberg Township. This partnership also did line cutting and a scintillometer survey as well as prospecting and assaying over a group of 23 claims in Olsen Township. Both E. Goodmurphy and I. Murphy were the recipients of OPAP grants in 1991 (E. Goodmurphy, Prospector, personal communication, 1991).

Haugeneder–Richards–Fleming

J. Haugeneder, D. Fleming and W. Richards have 5 claims on a copper-gold prospect in Chesley Township, northeast of Sault Ste. Marie. During the past summer, about 1 km of road was constructed to access the property; 1 diamond-drill hole of 160 feet (49 m) was drilled. The work was done with the aid of OPAP funding (W. Richards, Prospector, personal communication, 1991).

Julien, P.

P.E. Julien holds 20 claims in souteastern Casson Township. P.E. Julien did line cutting and a VLF-EM survey over part of the claim group in 1990. Trenching and prospecting was performed in 1991.

McLean, P.

P. McLean of South River, Ontario, holds 7 unsurveyed claims immediately west of Golf Lake, in Daumont Township. In 1991, P. McLean, with the aid of OPAP funding, did geological mapping, prospecting and a self-potential method geophysical survey over part of the claim group (P. McLean, personal communication, 1991).

Noranda Exploration Company, Ltd.

Noranda Exploration Company, Limited conducted geological mapping, trenching and sampling on parts of a 480 claim group optioned from Duration Mines Limited in 1991. Work was concentrated on a copper-bearing breccia in Ryan Township near the northern end of Mamainse Lake and on the Glenrock prospect, a gold occurrence in Archean mafic volcanic rocks in Palmer Township (R. Dahn, Noranda Exploration Company, Limited, personal communication, 1991).

Placer Dome Explorations Limited

Placer Dome Explorations Limited holds 18 claims in Loach Township in the Montreal River area. Line cutting and geological mapping were completed in the summer of 1991 (D. Hunt, Placer Dome Explorations Limited, personal communication, 1991).

Tims, A.

A. Tims currently holds 14 claims in Hembruff Township. Line cutting and sampling were completed in 1991, and an EM survey is currently underway at the time of writing (A. Tims, Prospector, personal communication, December, 1991).

Tri-Origin Exploration Limited

Tri-Origin Exploration Limited holds 100 claims in Runnalls Township in the northern part of Batchawana greenstone belt. Some resampling for gold was done in 1991. *The Northern Miner* (November 18, 1991) reports that the company plans to continue work on the Batchawana claims pending a planned public share offering on the Toronto Stock Exchange.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

The staff of the Sault Ste Marie Resident Geologist's office consists of G. Bennett, Resident Geologist, E.J. Leahy, Staff Geologist, B. Fremlin, Secretary, and J. Walmsley, Drill Core Library Geologist. In November, 1990, W. Wing completed a contract to compile a mineral-potential map for the Elliot Lake area in March, 1991.

Much of the Resident Geologist's time was divided between administrative matters and responding to public, industry and ministry enquiries. During 1991, the Resident Geologist was a member of the Mineral Resources Inventory Working Group, the Ontario Geological Map Committee and the Information Technology Subcommittee (current as of October, 1991).

The Resident Geologist made 2 visits to operating mines in the Elliot Lake area, 5 visits to active mineral occurrences, 13 visits to either inactive mineral occurrences or past-producing mines and 3 visits to potential industrial-mineral sites. During the summer and fall of 1991, the Resident Geologist conducted 4 field trips for members of the Ontario Geological Survey, the Finnish Geological Survey and for industry personnel to examine rocks of Huronian Supergroup between Sault Ste. Marie and Elliot Lake.

Two days were spent investigating road access and an overview of the geological features of the northern part of the Batchawana greenstone belt.

In December, the Resident Geologist made a presentation on the stratigraphy of the Elliot Lake Group of the Huronian Supergroup at the 1991 Mines and Minerals Division's annual Ontario Mines and Minerals Symposium, held in Toronto.

During 1991, final submission and editing was completed for a contribution to Special Volume 4, Part 1, of the *Geology of Ontario* describing the Huronian Supergroup and Associated Intrusive Rocks. A contribution was also made to those portions of the *Tectonic Assemblages of Ontario* theme maps depicting terrane of the Huronian Supergroup. Maps of the *Tectonic Assemblages of Ontario* theme form part of an integrated map folio which when released in its entirety in 1992 will include 6 other map themes, thus, complementing parts 1 and 2 of Special Volume 4, the *Geology of Ontario*. The production of these maps together with Special Volume 4, the *Geology of Ontario*, is to commemorate the centennial of the founding of the Ontario Bureau of Mines.

In May 1991, the staff of the Sault Ste. Marie Resident Geologist's office and Drill Core Library organized and participated in an introductory prospector's course at Elliot Lake. About 30 residents of Elliot Lake and the North Shore Improvement District area attended the classes.

Staff Geologist's Activities

During 1991, much of the Staff Geologist's time was taken up with routine office matters including discussions with prospectors, company geologists, consultants, rock hounds, the general public and various government personnel. Advice was given on rock and mineral identification, assays, exploration maps and reports, and assessment files, in addition to other topics. According to our records, the Sault Ste. Marie Resident Geologist's office averaged about 5 queries per day —in the manner of either an office visit, a telephone call or by mail—of which the Staff Geologist handled about 64%. Meetings were attended in Thunder Bay, New Liskeard and Toronto. Some other activities of the Staff Geologist are discussed below.

EDUCATIONAL

For educational purposes, the Staff Geologist engaged in the following: a) prepared a display for Mining Awareness Week exhibited for 3 days at the Station Mall; b) prepared a display for the Sault Ste. Marie Public Library which was exhibited for 1 week during Mining Awareness Week; c) prepared a display that was set up at the Ontario Ministry of Northern Development and Mines Northeast Region Seminar in Kirkland Lake for 2 days; d) prepared a display for the township of Plummer Additional, this having been set up for 1 week at the local arena for their Centennial celebrations; e) set up a display for 1 day at Johnson School in Desbarats for their open house and loaned rock, mineral and literature samples to the teaching staff for class use; f) loaned a selection of rock, mineral and literature samples to the Korah Public Library for 2 months in their display area; and g) prepared and loaned display material to the Economic Development Officer of the North Shore Development Association for use in an economic seminar held in Temagami. The Staff Geologist also made oral presentations to the St. John's Memorial Hall Men's Club in Sault Ste. Marie; at the Community Hall in Bruce Station, as part of the Plummer Additional Township centennial celebrations; and at a combined meeting of the Bruce Mines Municipal Council, the Bruce Mines Chamber of Commerce and the North Shore Development Association.

MINE HAZARDS

At long last, the investigative and remedial work resulting from the abandoned-mine-workings study conducted at Bruce Mines seems to be nearing completion. At the time of writing (November 25, 1991), the overburden cover at the Plummer Street site has been stripped to bedrock and the rock surface washed clean. The old mining stope had been worked all the way to the bedrock-overburden surface across the full width of the road without any rock crown pillar support. This roadbed was thus supported only by unconsolidated-fill material resting on very old (1860s) wooden stulls. This stope at surface varies from 2.5 to 3.5 m (8.2 to 11.5 feet) in width and is believed to be at least 150 feet deep. An engineered concrete slab bridging the stope will have been poured in late November, 1991, and the road opened shortly thereafter. The road was closed in September, 1988, when the hazard was first discovered but its extent not realized.

The decision has been made to close Caribou Road. Here, 2 stopes pass under the road, but vein material had been left as a crown pillar. However, the crown pillar has deteriorated to a Rock Quality Determination of 0, and a comparison of recent drilling with older records suggests that the crown pillar is thinning over time as pieces of vein quartz spall off into the deep stope below. Because of the high water table and the high cost of applying remedial measures to this area, the decision was made to post signs, erect guard rails and construct turnarounds on the Caribou Road on both sides of this hazard area. These measures will result in an inconvenience to some residents of both Bruce Mines and Plummer Additional Township, requiring detours of about 3 miles either to the east or west.

A visit was made to the former Crownbridge workings in Kamichisitit Township by the Staff Geologist together with Sault Ste. Marie Mining Claims Inspector, P. Morra. Some remedial mine work will be required at this site.

The Staff Geologist made 4 trips to the former Sill Lake Silver Mines workings in VanKoughnet Township. At the request of the new Mineral Development and Rehabilitation Branch, contract Drill Core Library Assistant, T. Plackitt, and the Staff Geologist reattached the screen cover to the portal, blocked the opening to a vent raise, fenced in an open manway and inspected the fill raise area and the plant buildings. Considerable vandalism has taken place. "Danger—Keep Out" signs were posted at various locations around the old mine workings and buildings.

LAND-USE PLANNING

The Staff Geologist was involved in providing input to the Official Plans of the Township of Thessalon, the Township of Johnson and the Township of Plummer Additional. There had been no mention of mining activity as a possible use of land in these townships but this has now been added to the list of potential land uses for consideration in the planning process.

Other land-use matters in which the Staff Geologist was involved were the Amendments to the Official Plan and Zoning Bylaw of the Municipality of Bruce Mines, a feasibility study of creating a new road link between Elliot Lake and Blind River and a review of a draft copy of the Earth Science System Plan of the Ontario Ministry of Natural Resources, Northeastern Region.

FIELD WORK ACTIVITIES

The Staff Geologist spent several field days devoted to mine-hazards work, as previously mentioned, at Bruce Mines, Sill Lake Silver Mines and in Kamichisitit Township. Property investigations were conducted in the Footprint Lake area of Gould Township, the old Grand Portage Mine location in Wells Township and the Jury Mine area in Patton Township. The quarry site of Ontario Trap Rock Ltd. in Bruce Mines was also mapped and sampled as part of a quality-control exercise.

Mineral Deposit Inventory

The Mineral Deposit Inventory (MDI) portion of the Geoscience Exploration Database (GED) is to be implemented in all the Resident Geologists' offices during 1992 by the Geoscience Data Center of the Ontario Geological Survey. MDI is a computerized map and linked (shallow) provincial data base of mineral deposits.

In the summer of 1991, the staff of the Resident Geologist's office and Drill Core Library completed the MDI data compilation (669 mineral occurrences) for the Sault Ste. Marie Resident Geologist's District. The original intent was to tranfer the data from earlier compilations, much of which was in digital form. However, positional-co-ordinates data derived from earlier compilations were, in part, taken from old geological maps with an inaccurate topographic fabric. As a result, many of the mineral-occurrence locations had to be transferred from original sources to 1:50000 scale topographic maps to obtain more accurate positional co-ordinates.

PROPERTY EXAMINATIONS

Footprint Lake Showings

U. Pellerin of Spragge, Ontario, presently holds 12 claims in Gould Township situated adjacent to and immediately to the north of the property of Gould Copper Mine. There are several small chalcopyrite showings on the Pellerin claims which he has opened up by trenching. In 1991 using funding from the OPAP program, U. Pellerin contracted a VLF-EM survey of the property. This geophysical survey indicated an anomaly trending along the axis of Footprint Lake and extending beyond the lake in both directions. Two other anomalies were also indicated. Mr. Pellerin attempted to find rock outcropping in these geophysically anomalous areas without success. Consequently, he resorted to a soil-sampling program to assess the geochemical response of the geophysically anomalous areas.

The Staff Geologist visited the property in September, 1991, guided by U. Pellerin. This property contains many vein-quartz outcroppings, several of which were examined for their potential as a possible source of "snow-white quartz", a commodity for which a market might easily be found. None of the quartz veins observed on the Pellerin claims satisfied the requirements of width, length, or colour. However, as Mr. Pellerin continues his prospecting of the copper occurrences he will be looking for other quartz-vein occurrences. Mapping by staff of the Ontario Geological Survey (OGS) of the Wakomata Lake area (Chandler et al. 1972) noted these observations: " In northwestern Gould Township quartz veins appear to be concentrated around Footprint Lake in the vicinity of negative lineaments."

The Bi-Ore Mine

Alexander Center Industries Limited of Sudbury holds 10 patented claims on the southern shore of Cobre Lake in Sagard Township, about 25 km north of Elliot Lake. The claim group is the location of the former copper producer which is now generally referred to as the "Bi-Ore Mine".

Harding (1939) reports that in 1931 the property was held by White Lake Mines Limited which developed 2 adits: one (the west adit) driven west from the shore of Cobre Lake for 1400 feet; the other was driven 1040 feet in an easterly direction from the shore of Cobre Lake commencing at a point approximately 600 m east of the portal to the west adit.

After World War II, the property was controlled by Bi-Ore Mines Limited. Between 1947 and 1949, 1647079 pounds of copper was produced from 2726 tons of concentrate shipped to the Noranda smelter in Noranda, Quebec, by Bi-Ore Mines Limited (Thomson 1951). Thomson (1951) also reports that 3479 tons of ore milled in 1948 averaged 3.74% Cu. Most of this production came from the west adit.

The Resident Geologist visited the Bi-Ore Mine in August, 1991; little of the old structures were seen. The impressive stone fireplace of the mine-manager's house, the floor of a small smelter and the concrete base of the crusher are about all that could be recognized (J.A. Robertson, Mineral Development Consultant, Ontario Ministry of Northern Development and Mines, personal communication, 1991). Sections of a road which ran along the lakeshore between the east adit and the crusher still remain visible.

The most impressive feature of the property is the large open trench or stope on a hill about 20 m high near the southern shore of Cobre Lake. The trench is about 70 m long by 3 m wide and was estimated to be up to 12 m deep. Although there is no record of production from the east adit, it is estimated that 4000 to 6000 tons of material was removed from the stope. Since there is no road to the top of the hill, the trench is presumably an open stope above the east adit; however, the portal of the east adit was not seen during this visit. The stope is surrounded by a wire fence and would not be easily accessed by a casual visitor to Cobre Lake. The area of the west adit was not examined.

Very little vein material was seen along the sides of the stope, but the nature of the mineralization is revealed in a trench situated at the west end of the main stope. This trench is about 20 m long by 2 m wide and 1 to 2 m deep. It extends down the hill to Cobre Lake to a point immediately west of the fenced area. It was probably one of the early exploration trenches.

The copper-bearing veins of the Bi-Ore Mine occur in pale-grey to pink, laminated siltstone of the Gordon Lake Formation. In the vicinity of the mine, the rocks strike at almost 090° and dip approximately 10°S. Large sills or dikes of Nipissing diabase intrude the Gordon Lake Formation about 200 m south of the deposit (Robertson 1975).

The mineralization remaining along the walls of the west end of the trench is mainly chalcopyrite with much malachite staining over calcite and chalcopyrite. Where observed by the Resident Geologist, the process of vein formation began with the deposition of quartz crystals 10 to 15 cm long and 0.5 to 2 mm wide which grew perpendicular to the walls of the vein. About 5 to 10 cm of chalcopyrite deposition followed the quartz; subsequently, this was followed by the deposition of both coarsely crystalline, black specular hematite and chalcopyrite within quartz veinlets and seams in a zone approximately 20 cm thick. Approximately another 20 cm of coarsely crystalline calcite with minor chalcopyrite and specular hematite forms the central portion of the vein. The area examined is probably not representative of the entire vein system.

Thomson (1951) examined the west vein and noted the main gangue mineral to be calcite with lesser amounts of quartz. He also noted breccias with fragments of wall rocks.

The Cobre Lake veins have a mineralogy (quartz + carbonate + chalcopyrite + specular hematite) consistent with the many copper-bearing veins occurring in rocks of both the Huronian Supergroup and Nipissing diabase of the Sault Ste. Marie–Elliot Lake area. These deposits are generally considered to be related to the intrusion of Nipissing diabase, which is host to many copper-bearing veins similar to those of the Bi-Ore Mine.

The Cooper Showing

D. Fleming and Y. Desjardins hold 5 unsurveyed claims in northeastern Hughes Township and these include 4 mineral occurrences. The claim holders carried out stripping, trenching, prospecting, sampling and some line cutting on and around these occurrences during the summer of 1991. D. Fleming and Y. Desjardins were successful recipients of OPAP funding. The Resident Geologist made brief examinations of 3 of these occurrences in August, 1991.

In 1969, the mineral occurrences were explored by W.F. Cooper who did power stripping on the breccia showing and drilled 4 diamond-drill holes totalling 748 feet in length (Cooper 1969). The property was held in the early 1980s by C. Campbell and S. Powley of Sault Ste. Marie. Campbell and Powley (1981) did some stripping, rock sampling and drilled 1 short hole with a pack-sack drill. The property was optioned by The Canadian Nickel Company (INCO) in 1982 which did geological mapping, ground induced polarization (IP) and magnetometer surveys, and drilled 6 holes for a total length of 322.77 m (Bell 1982).

Three mineral occurrences within a radius of about 300 m were examined during a visit to the property in August, 1991. The breccia showing forms a low hill, about 200 m west of a bush road, located at approximately Universal Transverse Mercator (UTM) civilian-system co-ordinates Zone 17, 291250E 5190940N. The rocks at this location are gneissic tonalite and younger, massive and brecciated granitic rocks cut by 2 pale-pink, fine-grained, northwest-trending, brecciated felsic dikes (felsite) approximately 3 m wide. The brecciated area is about 20 m wide and strikes approximately 320°. The breccia is composed of angular to rounded fragments of felsite. These felsite fragments are a few centimetres to 20 cm across and are set in a generally sparse matrix of comminuted rock fragments, in some places, while in other places they are set within crystalline (vein) quartz. The granitic rocks are brecciated and cut by branching quartz veins which extend perpendicularly outward from the felsite dike's northeast contact for approximately 5 m, however, the breccia does not occur along the southwest side of the dikes.

At the northwest edge of the outcrop, iron-bearing carbonate, chalcopyrite and some chalcocite, occur in the brecciated zone. Minor galena, sphalerite and an unidentified pale-grey metallic sulphide was noted in this area during an earlier visit by the Resident Geologist. It is reported that stripping, subsequent to the Resident Geologist's visit, uncovered a 40 foot wide brecciated zone with chalcopyrite, sphalerite and galena in this area. Assays are not available at this time (D. Fleming, Prospector, personal communication, November, 1991).

During a visit to this showing in 1981, the Resident Geologist collected selected grab samples which assayed up to 10 ounces Ag per ton and 4.5% Bi.

A report of The Canadian Nickel Company records the identification of stibnite and bismuthinite in the mineralized part of the breccia zone (assessment files, Resident Geologist's office, Sault Ste. Marie Resident Geologist's District, Sault Ste. Marie).

A showing, known as the "A-showing", occurs approximately 30 m east of a bush road and is approximately 350 m southeast of the breccia showing. A shallow rock trench has been dug by the present and previous holders of the claims across a 10 m wide zone of shearing and quartz veining occurring within Archean granitic rocks; this zone trends 150°. A 3 m wide composite dike of diabase and pink felsite along the southeast side of the trench is also cut by the quartz veins. A 7 m wide zone in the central area of the trench consists of a quartz-vein network with pods and lenses up to 20 cm across of massive, vuggy and sponge-textured pyrite and specular hematite. Minor patches of chalcopyrite occur within the pyritic areas. Very-thin veinlets of a pale-pink to orange mineral has been tentatively identified as laumontite—a calcium zeolite characteristic of veins in Keweenawan-age rocks occurring on the eastern shore of Lake Superior.

The third showing examined during the August visit was a shallow 2 by 9 m trench located in low swampy ground approximately 100 m north of the breccia showing. At this locality, a northwest-trending quartz-calcite vein breccia is partly exposed in the trench. The vein contains minor amounts of galena, sphalerite, as well as much dark-brown, earthy hematite and possibly manganese. Traces of pale-green fluorite and chalcopyrite were noted in this trench during an earlier visit by the Resident Geologist. Attempts to deepen the trench on this occurrence were prevented by flooding from the adjacent swamp.

Although the amounts of mineralization seen by the Resident Geologist was not impressive, the breccia showing and the A-showing noted above have both the same trend and character and probably are parts of the same vein system; thus, it suggests some continuity and, hence, economic potential for the property. D. Fleming reports that a northwest-trending quartz vein with chalcopyrite and sphalerite was found during the 1991 field season (D. Fleming, Prospector, personal communication, November, 1991). The latter occurrence is reported to be about 200 m southeast of the A-showing.

Copper Creek Showing

Blue Heaven Resources Limited holds a block of 25 claims in Kincaid Township. Part of this claim group was optioned from

Sault Ste. Marie prospectors, W. Richards and J. Haugeneder, in 1991. The Resident Geologist visited the property with J. Haugeneder in October, 1991.

Previous work on the prospect included trenching by Jalore Mines in 1956 and by Rio Tinto Canadian Exploration Limited in 1961; a self-potential (SP) survey by Farwest Tungston Copper Mines Limited in 1958; a ground electromagnetic (EM) survey by Croinor Pershing Mines Limited in 1963; and the drilling of 5 diamond-drill holes totalling 1712 feet by McKinney Gold Mines Limited in 1964.

The occurrence is exposed in 6 of 7 bulldozed trenches on claim 1061710 near the southern shore of Pancake Lake. The trenches were dug by J. Haugeneder and W. Richards in 1990 with the aid of OPAP funding. The walls in the No.2 trench (reported to show the best width and grade of copper mineralization) had collapsed during the 1991 spring snowmelt runoff.

The copper occurs mainly as chalcopyrite with minor bornite(?) and malachitein veins or as disseminated grains and lenses; this occurs across a 2 to 3 m wide area of fractured and altered Archean mafic volcanic rocks and feldspar porphyry. The mineralized zone is exposed discontinuously over a length of about 350 m in the trenches and in a creek bed which forms its most northerly exposure. There is potential for extension of the zone beyond its known length. A 50 cm wide, uncemented, hematite-stained shear zone, exposed in trench No.7, seems to form a well-defined eastern boundary of the mineralization.

The veins, which strike 160° and dip vertically, consist mainly of chalcopyrite, although the wider veins tend to have a quartz gangue. The veins are well-defined with sharp borders and generally are less than 3 cm wide. Parallel sets of 3 or 4 veins occur locally. The veins are commonly planar and continuous over at least 3 m. Dark alteration zones, a few centimetres wide, flank narrow veins of chalcopyrite cutting Archean feldspar porphyry.

Samples taken by J. Haugeneder in 1990 were reported to assay up to 9.54% Cu and 0.54 ounce Au per ton over 4.5 feet.

The overall grade across this width is probably less than 1% Cu in the trenches examined by the Resident Geologist, but there is the potential for extensions along strike. The massive, continuous nature of many of the chalcopyrite veins suggest that an EM survey would be effective in the search for extensions of the vein system. The chalcopyrite veins intersect an Archean porphyry dike at a high angle. This feature, along with the open nature of some shearing associated with the veins, suggest that the mineralization may not be directly related to the enclosing Archean rocks but, instead, has been emplaced during the period of Keweenawan-age volcanic activity which centred around Lake Superior. Laumontite, a pink zeolite characteristic of Keweenawan- age veins in the Mamainse area, was tentatively identified in one of the veins on this property.

Chalcopyrite in Dolostone, Fenwick Township

Born (1987) described a previously unreported occurrence of dolostone in Fenwick Township, about 25 km north of Sault Ste. Marie. Bennett et al. (1989) proposed that the dolostone could be correlated with the Gordon Lake Formation of the Huronian Supergroup and also the Kona Dolomite of the Marquette County area in Michigan. It is acknowledged that the latter correlation is not accepted by all workers. It should be noted, however, that stratabound copper occurs at the base of the Gordon Lake Formation in Sagard Township of the Elliot Lake area (Chandler 1988). The Kona Dolomite contains large but low-grade (subeconomic) copper deposits in the basal siltstone units (Clark 1974).

During an examination of the dolostone in Fenwick Township, the Resident Geologist noted very fine-grained pyrite with specular hematite and, in places, minor amounts of chalcopyrite occurring as disseminated grains and seams within brown-weathering, grey to pale-pink, fine-grained dolostone. The mineralization was found widely dispersed over the exposed outcrop (ca. 30 m along strike and a few metres across) which is situated on the north-facing slope of a ridge approximately 150 m north of the centre of Section 7, Fenwick Township. There was no evidence of a direct structural control of the mineralization (veins, shearing, etc.). A block of dolostone float on the hill was found to contain a nodule or lens (about 4 cm across) of massive chalcopyrite. Copper staining was seen on another piece of float about 50 m west of the outcrop. Close to the latter location, there were several angular pieces of siliceous, graphitic float which also contained much disseminated pyrite but no visible copper mineralization. Seven selected specimens, most with visible chalcopyrite, were analyzed for Cu, Pb and Zn by the Geoscience Laboratories Section of the Ontario Geological Survey. The results in percent Cu are as follows: less than 0.05%, 0.03%, 0.05%, 0.1%, 0.2%, 0.2% and 3.7%. The latter high value is from a chalcopyrite-rich nodule or lens. The Zn values are less than 30 ppm and the Pb values are less than the detectibility limit of 10 ppm. The results of analyses for Au and Ag are not available at this time. The overall Cu content of the dolostone outcrop is estimated to be very low, certainly much less than 0.1%. However, this appears to be a new and unexplored copper occurrence in what some geologists might consider to be a very favorable environment for a large, low-grade copper deposit.

The occurrence was examined in a cursory manner by the Resident Geologist in November, 1991. A heavy snowfall the following day precluded a more detailed examination of the area.

The genesis of the occurrence is problematical. The copper-bearing outcrop is only a few tens-of-metres from a major fault separating the dolostone unit and the Lorrain Formation of the Huronian Supergroup. This fault zone may be the source of the siliceous, graphitic rock noted previously. There are some altered, mafic rocks (Nipissing diabase?) within a hundred metres of the copper-bearing area. There are well-documented copper-magnetite-bearing skarns in areas where Nipissing diabase intrudes limestone lithologies of the Huronian Supergroup. However, neither were typical skarn minerals noted in this occurrence nor does this copper occurrence display the vein structure and brecciation typical of the vein-type copper occurrences of the Sault Ste. Marie—Elliot Lake area; nonetheless, there are some similarities in the mineral assemblage (e.g., chalcopyrite + specular hematite). Alternatively, the sulphides could be either syngenetic or diagenetic in origin. The depositional environment of fine-grained, laminated dolostone, such as that in Fenwick Township, is thought to be similar to that of evaporites. Such an environment is also conducive to base metal concentration (sabkha process).

The area of this occurrence is indicated on claim maps as patented for surface and mining rights, with gold and silver controlled by the crown (government of Canada).

A Barite Occurrence in Fenwick Township

In 1988, G. Bennett, Resident Geologist, noted the presence of barite within a dolostone unit in Fenwick Township. The dolostone was provisionally correlated with the Gordon Lake Formation of the Huronian Supergroup (Bennett et al. 1989). The barite locality was re-examined in September, 1991.

The barite mineralization occurs in at least 2 locations, approximately 20 m apart, on the steep south face of a hill outcropping pale-grey dolostone; this is situated near the southeast corner of the northeast quarter of Section 7, Fenwick Township. The partly wooded, moss-covered surface of the hill makes accurate delineation of the barite difficult. The mineral has the form of pale-pink to pale-orange, very fine-grained barite occurring as both massive and tabular crystal aggregates—the latter up to 5 cm long.

The eastern location is an irregular vein or lens, 15 to 40 cm wide, striking 020° and dipping 55°W over an observed length of about 7 m. Laminations in the adjacent dolostone indicate that at least part of the vein is concordant with the surrounding rocks. In places, inclusions of dolostone occurring within the barite also show parallel orientation of laminae with the surrounding dolostone. Some of these inclusions have serrated borders. These features suggest replacement of the dolostone by barite. The barite vein is not obviously zoned, but the coarse-grained tabular crystals seem to occur mainly on the west (hanging wall) side of the vein or lens. None of the thin, quartz-filled fractures, common in the surrounding dolostone, were seen to cut the barite. Deep-red, hematitic pseudomorphs after rhombohedral carbonate are sparsely distributed throughout the barite.

The second occurrence of barite is about 20 m west of that described above. This is a vein of pale-orange barite, a few centimetres wide, striking 080° and dipping 65°S. The barite vein cuts across the bedding which strikes 045° and dips 40°W.

The origin and mode of emplacement of the barite is not clear at this time. The irregular boundaries with the dolostone suggests replacement of the dolostone by barium-bearing solutions, perhaps during diagenesis. A review of publications in the Resident Geologist's office indicates that the dolostone of Fenwick Township has many of the characteristics of primary dolostone formed in restricted lagoonal environments. Although the Resident Geologist could find no published accounts of syngenetic barite formed with dolostone, other sulphate minerals normally found in an evaporite environment (such as gypsum or anhydrite) are commonly associated with primary dolostone.

The small size of the barite occurrence and the pinkish color—due to the presence of hematite—makes this occurrence of no apparent economic value.

THE SAULT STE. MARIE DRILL CORE PROGRAM

The Drill Core Library Geologist for the Sault Ste. Marie Drill Core Library is J.R. Walmsley. Contract staff acting as Drill Core Library Assistants over the year included R. McNally from January to the end of March, R. Henri for the month of June and A. Plackitt for October and November. The Experience 1991 program summer assistant was B. Arbour, and co-op students employed were M. Entwhistle and C. Smith.

A total of 4760 m of drill core was collected by library staff in 1991. This included 3729 m from the Sault Ste. Marie Resident Geologist's District and 1031 m from the Wawa Resident Geologist's District. Of the total core collected, 1632 m were acquired as representative sections. A representative section is defined as drill core which preserves, in order to serve as an example, a specific geological environment.

The Sault Ste. Marie Drill Core Library currently stores drill core from 1340 drill holes; 823 drill holes from the Sault Ste. Marie district and 517 drill holes from the Wawa district. These holes comprise a total of 92 000 m of core, of which 84 324 m is stored at the indoor facility and 7671 m is stored at a temporary outdoor facility.

The Algoma Steel Corporation Ltd. has agreed to donate drill core from their exploration projects dating back to the 1950s. These projects covered properties across northwestern Ontario and parts of northeastern Ontario and, for the most part, involved assessing iron formations only for their iron content. Approximately 75 000 m of core is available, but only about half of it can be linked to locations and drill logs. Much of the summer was spent by the library staff compiling and sorting the Algoma Steel Corporation Ltd. files.

Noranda Exploration Company, Ltd. completed an extensive resampling and relogging of drill core from the Jogran Porphyry which is located in Ryan Township. This was part of a larger exploration program carried out in the area during the summer.

As a follow up to the assessment of the indoor drill-core inventory completed in 1990, a survey of the outdoor drill-core inventory was completed, and any discrepancies with the library data base were corrected.

Involvement of drill core library staff in other projects included computer assistance in the compilation of the Mineral Deposit Information (MDI) data base for the Sault Ste. Marie and Elliot Lake areas, a presentation on prospecting at a prospector's course held in Elliot Lake and a contribution to a local-mall display set up for Mining Awareness Week.

Visits to the drill core library from November 15, 1990, to November 15, 1991, totalled 121. In addition to client visits, 2 delegations representing foreign governments were given tours of the facility. One delegation was from the Republic of China and the other from Chile.

Those wishing to view drill core should notify the Sault Ste. Marie Drill Core Library in advance to ensure that complete service can be provided. Anyone wishing to donate drill core or requiring a copy of the inventory catalogue should contact either the drill core library or the Resident Geologist's office.

SUGGESTIONS TO PROSPECTORS

The current slump in metal prices and the continuing economic recession tends to get us all a little depressed at times. However, "every cloud has a silver lining" or, perhaps, a gold or copper lining. The bright side of the present situation is that we should expect to have more claims coming open as companies tighten their belts (Figure 12.4). This leaves more ground available to the prospector.

I have no reservations about stating that the best prospecting ground is in the Resident Geologist's office. "Prospecting" the assessment files and published reports is time well spent, especially on blustery winter days. Who knows what "gems" lie hidden in a brief report written many years ago?

The doubling of cobalt prices over the past 12 months (*The Northern Miner*, December 24, 1990, and November 25, 1991) has caused some interest. Cobalt may be a commodity worthy of special attention by the prospector. However, short-term increases in a given metal's price may reflect short-term political instability rather than a real reduction in long-term supply.

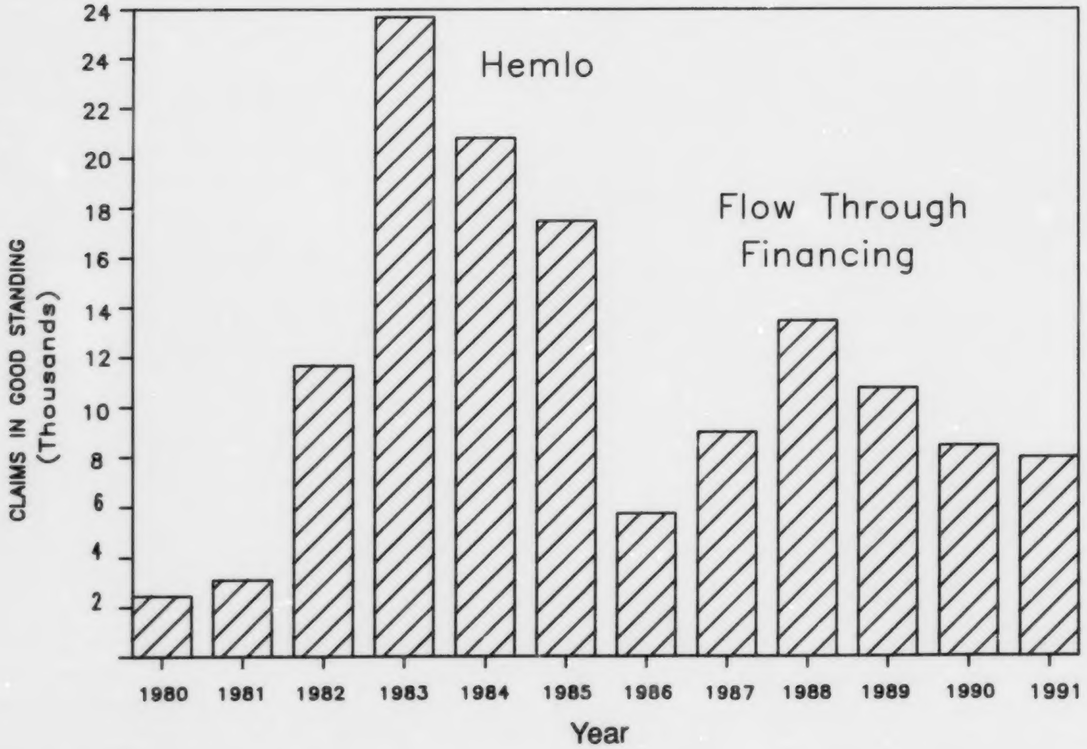

Figure 12.4. The number of claims in good standing for the Sault Ste. Marie Mining Division from 1980 to 1991.

The Batchawana greenstone belt is still the prime prospecting area in the Sault Ste. Marie Resident Geologist's District. The western part of the belt has been affected by Keweenawan-age faulting and igneous activity and may still hold undiscovered Keweenawan-age deposits of the Tribag type. A broad area extending eastward from Batchawana Bay to Ranger Lake has produced many base metals, silver and molybdenum occurrences. The area is underlain mainly by Archean granitic rocks and remnants of Archean greenstone. Major lineaments extending eastward from Lake Superior towards Ranger Lake (Giblin and Leahy 1979) and the known occurrence of Keweenawan-age dike rocks, as far east as Ranger Lake, suggests that this area was also affected by the Keweenawan-age activity.

Interest in industrial minerals continues. The area between Sault Ste. Marie and Elliot Lake contains stone of a variety of colours and hues. There is a market for crushed stone with an interesting and uniform colour which can be extracted at a competitive price. In this regard, the recent announcement of a proposal to construct a plant at Elliot Lake to produce panels finished with crushed stone is of interest (*Elliot Lake Standard*, October 9, 26 and November 9, 1991).

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

Preliminary reports of the following projects can be found in Summary of Field Work and Other Activities 1991, Ontario Geological Survey, Miscellaneous Paper 157.

In August 1991, J. Fortescue of the Geophysics/Geochemistry Section completed the Cow River regional geochemical survey. This was the last of 5 lake-sediment geochemical surveys covering the Batchawana greenstone belt, approximately 70 km north of Sault Ste. Marie. The survey has a sample density of 1 sample per 1.19 km^2. The concentrations of 35 elements were determined from lake sediments as well as ph, Ca and Mg levels in samples of lakewater (Fortescue et al. 1991).

M.C. Rogers of the Precambrian Geology Section completed geological mapping of the eastern portion of the Whiskey Lake greenstone belt about 20 km east of Elliot Lake (Rogers 1991a).

In the summer of 1991, M.C. Rogers completed geological mapping of the western half of the Ompa Lake greenstone belt, approximately 30 km north of Elliot Lake (Rogers 1991b).

F.W. Breaks of the Precambrian Geology Section completed geological mapping of the granitic terrane in the Mount Lake area, north of Elliot Lake (Breaks 1991).

M.J. Ford of the Engineering and Terrain Geology Section completed geological mapping of Quaternary deposits in the Rawhide Lake area, approximately 30 km north of Elliot Lake (Ford 1991).

RESEARCH BY OTHER AGENCIES

M. Byron of Laurentian University, Sudbury, continued a lithogeochemical study of the Whiskey Lake and Ompa Lake greenstone belts of the Elliot Lake area. This project is being carried out collaboratively by the staff of Laurentian University and the Ontario Geological Survey. The preliminary results of this work are presented in Byron and Whitehead (1991a, 1991b).

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13. Timmins Resident Geologist's District—1991

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[6]Drill core Library Geologist, Timmins, Field Services Section, Ontario Geological Survey – Information Services Branch

INTRODUCTION

In 1991 there were 12 active mining operations in the Timmins Resident Geologist's District: 3 base metal mines, 6 underground gold mines, 2 open pit gold mines, and one open pit industrial mineral producer. There were two advanced underground exploration and development programs (Figures 13.1a–e).

Operations at the Bell Creek Mine and at the Langmuir No. 1 Mine were officially suspended in late 1991. Low metal prices, high production costs and a decrease in ore grades resulted in significant staff reductions at the remaining producers. Including mine closures, an estimated 200 mine workers were laid off in the Timmins Resident Geologist's District during 1991.

Major mining and exploration companies based in the area operated under budget constraints and with reduced staffing. The few junior mining companies still active in the area were a vital element in generating new exploration and development targets. Prospectors and developers continued to make good use of funding supplied under various government incentive programs including the Ontario Prospectors Assistance Program and the Ontario Mineral Incentive Program.

CLAIM-STAKING ACTIVITY

There are currently 19 705 active claims (16 hectare units) in the Porcupine Mining Division. From January to December 1991, 4709 claims were recorded. This represents an 8% increase over claims recorded during that same time period in 1990 (Table 13.1).

Areas of highest interest as evidenced by claim staking are as follows:

1. as in previous years, the majority of staking, in this case 46%, was concentrated on gold and base metal prospects within a 50 km radius of Timmins
2. over 20% of the claims recorded were staked for McKinnon Prospecting over an underexplored area north of Highway 11 and centred some 60 km northwest of Hearst; the commodity targeted for exploration is gold
3. almost 20% of claims recorded were staked in the Swayze greenstone belt, primarily in proximity to known gold and base metal showings
4. an additional 4% of staking was concentrated on the Montcalm–Poulett area.

GOVERNMENT INCENTIVE PROGRAMS

Ontario Prospectors Assistance Program (OPAP)

During 1991, the Ontario Prospectors Assistance Program continued to provide a vital source of funding to grassroots exploration in the Timmins area.

Under OPAP, 57 programs were designated to receive funding representing a value of $558 542 awarded or approximately 14% of the provincial total.

The major commodity sought by OPAP recipients continued to be gold, with 43 projects funded. In addition, there were 13 base metal and 1 diamond exploration programs supported by OPAP.

Ontario Mineral Incentive Program (OMIP)

In August 1991, OMIP regulations were changed to allow all designated mineral exploration programs in northern Ontario to be eligible for a grant equal to 50% of acceptable expenditures. Under OMIP, 35 programs in the Timmins Resident Geologist's District received funding. The $2 484 604 awarded represented 26% of the provincial total. A similar distribution of commodities sought was noted with 26 gold, 5 base metal and 4 industrial mineral programs receiving support under OMIP.

Table 13.1. Summary of claims recorded and assessment work credit.

Year	Claims Recorded	Claims Cancelled	Claims Active	Diamond Drilling (Man Days)	Geophysical Surveys (Man Days)	Geological Surveys (Man Days)	Total Man Days
1991*	4 682	4 367	19 879	62 409 $ 624 764	199 836 $ 104 667	8140 $ 76 540	279 806 $ 1 067 217
1990	4 864	10 431	19 472	130 847	112 881	20 638	313 085
1989	4 724	12 347	24 715	172 600	218 347	46 227	522 490
1988	5 867	6 117	34 553	119 758	325 685	17 260	532 820
1987	8 934	4 402	34 474	120 384	612 631	32 001	807 277
1986	17 889	8 689	33 181	129 932	481 547	26 266	717 522
1985	6 052	10 024	23 207	131 330	278 881	34 032	503 338
1984	7 633	11 040	27 179	140 864	495 323	51 723	738 038
1983	11 859	4 967	30 586	128 126	199 892	44 755	407 161
1982	5 420	6 457	23 694	91 203	359 970	36 178	596 097
1981	8 934	2 934	24 731	114 823	261 301	23 177	471 827
1980	10 742	1 778	18 753	59 993	212 208	5 246	296 852
1979	3 975	2 504	9 597	40 850	59 605	5 480	151 003
1978	3 623	4 429	8 126	38 056	47 333	1 880	94 045
1977	2 438	4 336	8 932	77 496	135 134	3 755	228 090
1976	5 837	3 621	10 830	25 819	43 920	2 140	97 258
1975	4 162	4 142	8 614	83 388	108 420	1 300	200 034
1974	3 456	3 692	7 594	69 341	52 128	3 146	142 136
1973	2 258	3 728	6 460	58 495	50 022	2 500	114 917
1972	2 980	3 509	7 939	55 900	89 560	(1 400)	149 387
1971	3 840	3 708	(8 500)	52 401	131 385	1 050	195 457
1970	3 903	3 916	(8 600)	96 946	59 013	5 560	167 465

* Due to changes in regulations implemented by the New Mining Act as of June, 1991, assessment credit totals shown in this table are reported in mandays for January to June and in dollar value of expenditures for July to December.

Brackets indicate approximate figures.

MINING ACTIVITY

Base Metals

FALCONBRIDGE LIMITED, KIDD CREEK MINE

Production from the Kidd Creek Mine in Kidd Township in 1991 was 3.77 million tonnes at a grade of 3.24% Cu, 4.05% Zn, 0.12% Pb and 64 g/t Ag (Table 13.2). Approximately 74% of the production came from the No. 1 Mine, the bottom level of which is 2500 feet below surface. The No. 2 Mine produced most of the remaining 24% of the ore with the bottom level being 4600 feet below surface.

On November 18, 1991, the No. 3 (internal) shaft was completed, being collared at 4700 feet below surface with the hoist at 4500 feet and sunk to a depth of 6922 feet below surface.

In October, 1991, mining began in the No. 3 Mine with a stope being developed at 4700 feet below surface. The bottom mining level in the No. 3 Mine will be at 6000 feet. An exploratory drill program will commence in 1992 to trace the ore down from 6000 feet to 7000 feet.

The internal ramp which extends from surface is now down to 5400 feet. By early 1992, it will be down to 5600 feet.

Underground exploration in 1991 included approximately 3000 m of drilling southeast of the known orebody in the No. 2 Mine. A new zinc-rich zone with some copper values was intersected 50 to 100 m away from known ore between 4000 and 4200 feet below surface. Tonnage potential is small, between 100 000 and 200 000 t. It is thought that this zone may represent a downdip remnant of the south orebody.

Approximately 10 000 m of underground reconnaissance drilling was done in the south and west part of No. 2 Mine to test the hanging wall basalts for possible stacked ore lenses. A narrow, altered rhyolitic section was intersected, however, no sulphide mineralization was intersected.

Deep surface diamond drilling continued in 1991 1 km northwest of the mine workings exploring the 'North Rhyolite' which may be a faulted extension of the 'Mine Rhyolite'. 'Curdy' looking rhyolite, similar in appearance to the mine rhyolite which hosts the ore (i.e. brecciated with sericite and chlorite fracture fills), was intersected in 1990. Follow-up drilling in the fall of 1991 intersected a 0.8 m section grading

Table 13.2. Production statistics 1991 for active mining operations, Timmins Resident Geologist's District.

Abbreviations

*.............. Average grade of underground and pit production
T... Imperial tons
opT .... Ounces per ton
L...................................... Lateral development
U.............................. Underground diamond drilling
#....................... Total of underground and pit production
t .... Metric tonnes
g/t .... Grams per tonne
V .... Vertical development
S.................................... Surface diamond drilling

Property	Production	Grade	Tons Milled	Recov. %	No. of Stopes	Mine Dev.	Drilling	Reserves (yr)	Number Employed
Falconbridge Limited — Kidd Creek Mine		3.24% Cu 4.05% Zn 64 g/t Ag 0.12% Pb	3 767 000 t	95% Cu 80% Zn 76% Ag	53	7386m L 4719m V	125 357′ U 23 054′ S	41 197 103 t @ 3.44% Cu, 5.01% Zn, 65 g/t Ag, 0.17% Pb (90)	2319
Timmins Nickel Inc. — Redstone Mine (Ni)	4 209 044 lbs	2.42% Ni	105 305 T	81.5%	50	9160′	350′ U	331 659 T @ 2.21% Ni (91)	70
Timmins Nickel Inc. — Langmuir No. 1 (Ni)	2 221 000 lbs	1.73% Ni	95 242 T	67.4%	10	N/A	350′ U 3063′ S	49 321 T @ 2.85% Ni (91)	12
Canamax Resources — Bell Creek Mine (Au)	24 962 oz	6.67 g/t Au	124 354 t	93.6%	N/A	571m L 452m V	4640m U 150m S	365 694 t @ 6.99 g/t (90)	99
Falconbridge Gold Corp. — Hoyle Pond Mine (Au)	54 057 oz	18.54 g/t	100 196 t	90.05%	14	624m	16 846m U	271 343 t @ 16.5 g/t (91)	100
Placer Dome Inc. — Detour Lake Mine (Au)	119 000 oz	4.9 g/t Au	798 000 t	94.5%	7	5286m	21 127m U 1584m S	5 370 000 t @ 5.3 g/t (91)	267
Placer Dome Inc. — Dome Mine (Au)	114 765 oz	0.119 opT*	1 267 200 T#	96.0%	47	10 654′ L 1280′ V	51 026′ U 36 000′ S	6 900 000 T @ 0.144 opT (90)	342
Royal Oak Mines Inc. — Timmins Operations (Au)	92 441 oz	0.084 opT*	1 219 962 T#	90.2%	18	13 791′ L 4751′ V	44 157′ U 23 963′ S	8 594 000 T @0.082 opT (90)	325
St. Andrew Goldfields Ltd — Stock Township Mine (Au)	20 082 oz	0.151 opt	142 698 T	93.5%	10	1989′ L 420′ V	10 815′	258 000 T @ 0.163 opT (91)	94
Luzenac Incorporated — Reeves Mine (talc)	38 000 T	N/A	113 000 T	N/A		N/A	N/A		50

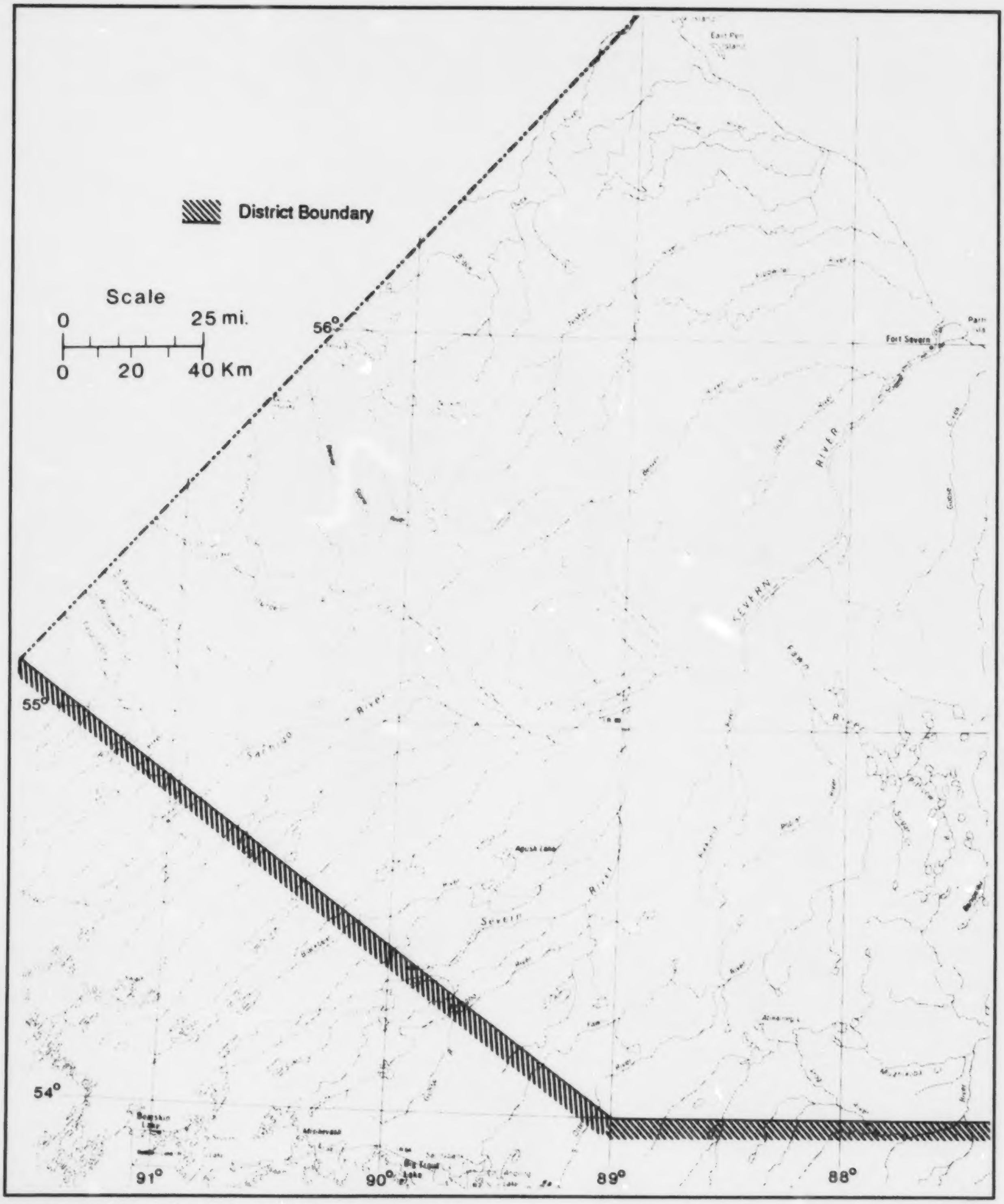
▨ District Boundary
Scale
0
25 mi.
0
20
40 Km
56°
55°
54°
91°
90°
89°
88°
Fort Severn
SEVERN
RIVER
Sachigo
River
Severn
River
Agusk Lake
Big Trout Lake

Figure 13.1a. Timmins Resident Geologist's District—no activity.

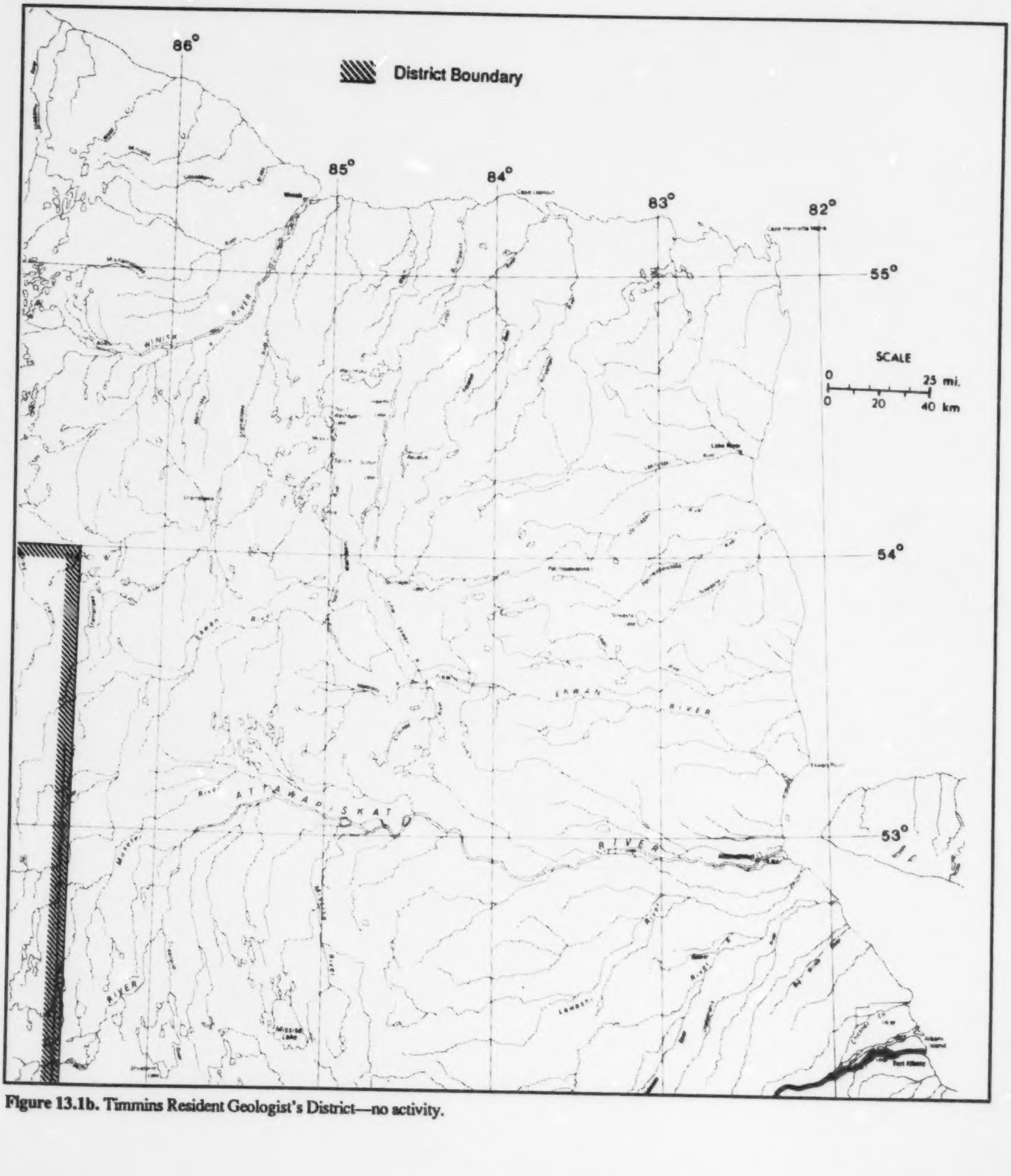
86°
85°
84°
83°
82°
55°
54°
53°
District Boundary
SCALE
0
25 mi.
0
20
40 km
WINISK RIVER
EKWAN RIVER
ATTAWAPISKAT RIVER
RIVER

Figure 13.1b. Timmins Resident Geologist's District—no activity.

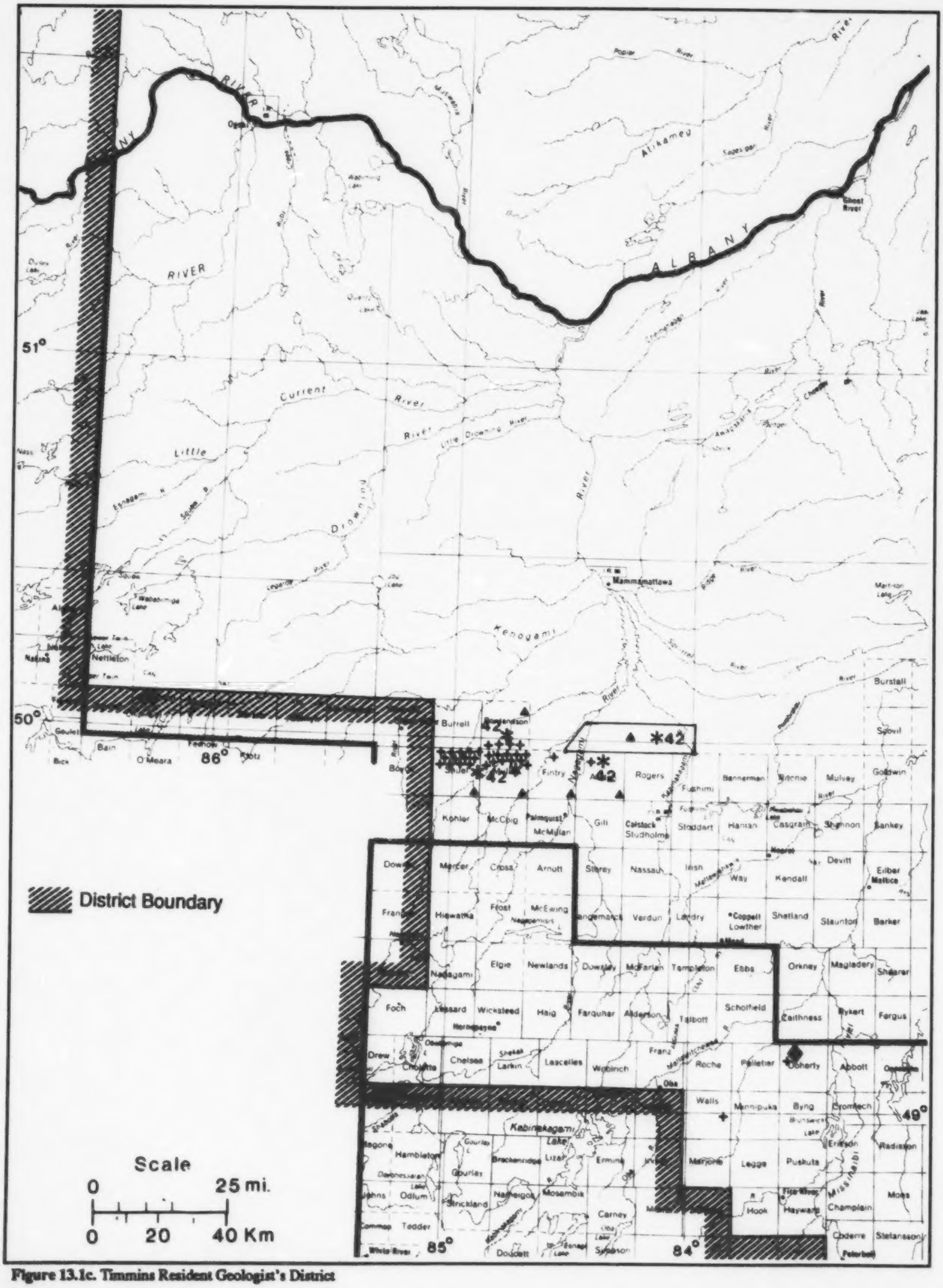
Poplar River
Albany River
Ogoki
Attawapiskat?
Alikameu
Sagesgaw River
Ghost River
ALBANY
RIVER
51°
Current River
Little Drowning River
Little
Drowning
Kenogami
River
Mammamattawa
Nettleton
Kenogami River
Burstall
Scovil
50°
Goulet
Bain
O'Meara
86°
Burrell
*42
*42
*42
Fintry
Rogers
Fushimi
Bannerman
Ritchie
Mulvey
Goldwin
Kohler
McCoig
Palmquist
McMillan
Gill
Caithness
Colstack
Studholme
Stoddart
Hanlan
Casgrain
Shannon
Sankey
Dowsley
Mercer
Cross
Arnott
Storey
Nassau
Irish
Way
Kendall
Devitt
Eilber
Mattice
Franz
Hiawatha
Frost
McEwing
Nagagamisis
Verdun
Landry
Coppell
Lowther
Shetland
Staunton
Barker
Nagagami
Elgie
Newlands
Dowsley
McFarlan
Templeton
Ebbs
Orkney
Magladery
Shearer
Foch
Lessard
Wicksteed
Haig
Farquhar
Alderson
Talbott
Scholfield
Caithness
Rykert
Fergus
Drew
Chelsea
Larkin
Lascelles
Wolinich
Franz
Roche
Pelletier
Doherty
Abbott
Walls
Mannipuka
Byng
Cromlech
49°
Kabinakagami Lake
Hambleton
Gourlay
Brackenridge
Lizar
Errington
Marjorie
Legge
Puskuta
Erickson
Radisson
Odlum
Strickland
Nameigos
Mosambik
Carney
Hook
Hayward
Champlain
Moss
Tedder
White River
85°
Doucett
Simpson
84°
Coderre
Stefansson
District Boundary
Scale
0
25 mi.
0
20
40 Km

Figure 13.1c. Timmins Resident Geologist's District

LEGEND

Timmins Resident Geologist's District

▲ Township for which assessment received 1991

+ Claims staked, 1991 (approx. 1 '+' per 20 claims)

2★ Exploration activity, 1991
(keyed to Table 13.3)

◆ Property examinations, 1991

2.25% Cu at approximately 4500 feet below surface. Although not of economic significance, this drill intersection increases the exploration potential of the area (Falconbridge Limited, Kidd Creek Mine, personal communication, 1991).

TIMMINS NICKEL INC., BHP-UTAH MINES LTD., REDSTONE MINE

In December, 1991, Timmins Nickel Inc. acquired full ownership of the Redstone Mine by purchasing the 49% interest held by BHP-Utah Mines Ltd. In the terms of the agreement, BHP-Utah relinquished net smelter royalties on the Redstone Mine but retained the right to earn a 2% net smelter royalty on any new mines found on the Redstone property.

Production during 1991 at the Redstone Mine was 105 305 tons at a grade of 2.3% nickel. Mining at the end of 1991 occurred in 8 active stopes with 3 stopes under development. Fifteen percent of the ore came from pillar recovery in the upper levels. Mining from the 700 foot level commenced at the end of 1991, as well as ramping to the 800 foot level. No proven ore reserves exist below the 700 foot level, but plans are to drift along the favourable ultramafic contact and on the downdip extension of the ore on the 800 foot level to prove up reserves before mining.

The orebody is currently delineated over a strike length of 900 feet and dips at an average of -60°, with local changes from -20° to -90° and a slight plunge to the east. Widths of ore can change dramatically from 4 inches to 12 feet both along strike and downdip, and an open-stoping mining method with some backfilling (about 25% of the stopes are filled with waste rock for support) is used.

Underground drilling has been done to outline ore at the extremities of the deposit which resulted in an increase in reserves.

At the end of 1990, Timmins Nickel Inc. concluded negotiations with Marshall Minerals Inc. to lease the Carshaw mill in Shaw Township. Ore from the Redstone Mine was previously being milled at the GOMILL facility at Royal Oak Mines Inc., Schumacher Mine. Timmins Nickel spent over $1.9 million refurbishing the mill and increasing the capacity from 400 to 700 tons per day (Timmins Nickel Inc., BHP Utah Mines Ltd., personal communication, 1991; L.E. Luhta, personal observations, 1991).

TIMMINS NICKEL INC., LANGMUIR NO. 1 MINE

In 1991, production at the Langmuir No. 1 Mine was 95 242 tons at a grade of 1.73% nickel. Production occurred from 3 zones the West, Central and East. All the ore was mined above the 315 foot level and accessed via a decline from surface. The bottom of the ramp is at 350 feet below surface. Underground development began in late 1990 with production beginning in April 1991, and was completed at the end of 1991 with the mucking out of a stope in the Central Zone. Mining was by shrinkage and longhole above 250 feet and all longhole below 250 feet. Ore still remains in the East Zone below the 315 foot level, however, mining will be postponed until the nickel price increases.

An underground diamond-drilling program was done at the end of 1991 to explore for the eastern and downdip extension of ore in the East Zone and the downdip extension of ore in the Central Zone.

Nickel mineralization occurs in 3 subparallel lenses which are steeply dipping and occur at the contact between komatiitic rocks and felsic to intermediate volcanic rocks. The stratigraphy strikes northwest and the known mineralization has a strike length of 500 feet and has been traced to 420 feet below surface. The ore zones are interpreted to be along the same stratigraphic horizon and within a tightly folded structure which has undergone strike slip fault movements subparallel to the stratigraphy and the axial plane of the folds. Underground development has shown that the ore zones meander and are boudinaged. As compared to the ore at the Redstone Deposit, which consists mostly of pentlandite with minor pyrrhotite (massive sulphides grade between 15% and 20% Ni), the ore at Langmuir No. 1 consists mostly

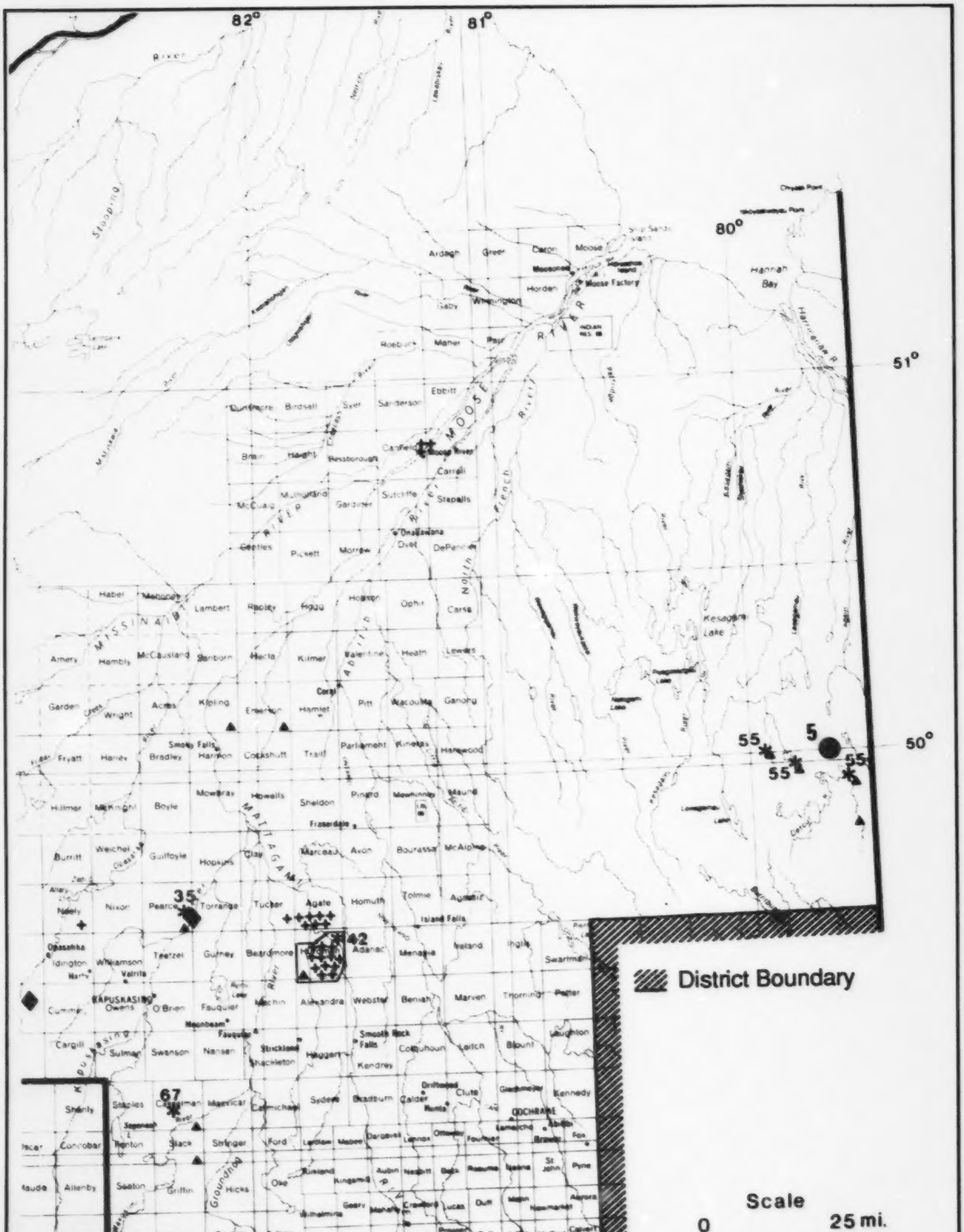
82°
81°
80°
51°
50°
Moose Factory
Moosonee
Hannah Bay
Harricanaw R.
Kesagami Lake
MOOSE RIVER
North French River
MISSINAIBI
MATTAGAMI
ABITIBI
KAPUSKASING
Smooth Rock Falls
Island Falls
Fraserdale
Onakawana
COCHRANE
Smoky Falls
Groundhog River
5
55
55
55
35
42
67
District Boundary
Scale
0
25 mi.
0
20
40 Km

Figure 13.1d. Timmins Resident Geologist's District

LEGEND

Timmins Resident Geologist's District

▲ Township for which assessment received 1991

+ Claims staked, 1991 (approx. + per 20 claims)

2★ Exploraton activity, 1991
(keyed to Table 13.3)

◆ Property examinations, 1991

2● Producing Mine, 1991
(keyed to Legend for Figure 13.2)

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of pyrrhotite with a lesser amount of pentlandite (massive ore grades between 4% and 8%). Magnetite is a common accessory in the ore at Langmuir No. 1 but is rare at the Redstone Deposit.

Milling of the Langmuir No. 1 Mine ore was done at Timmins Nickel's Carshaw mill in Shaw Township (Timmins Nickel Inc., personal communication, 1991; L.E. Luhta, personal observations, 1991).

Precious Metals

CANAMAX RESOURCES INC., BELL CREEK MINE

On November 27, 1991, Canamax Resources Inc. closed the mine and mill operations at the Bell Creek Mine due to the continued weakness in the price of gold relative to high production costs. However, in early November, Falconbridge Gold Corporation and Canamax Resources Inc. negotiated an agreement wherein Falconbridge Gold would purchase the Bell Creek Mine and mill. The transfer of ownership took place December 17, 1991. No production from the mine is planned, however, the mill will begin processing gold ore from Falconbridge Gold Corporation's Hoyle Pond Mine on January 2, 1992. The mine will be put on a care and maintenance basis with a possible underground exploration program to be done in the future.

During 1991, the Bell Creek Mine produced 124 354 t grading 6.67 g/t Au. Production came from the North 'A' Vein, the Bell West Zone and the Marlhill Zone.

The lowest mining level at the Bell Creek Mine was at 300 m below surface. The shaft is down to the 240 m level and access to the 300 m level was by a ramp completed in early 1991. The North 'A' Zone, as defined, is mined out above the 240 m level, however, potential exists laterally along the zone. Prior to the mine's closure, mining took place between the 300 m level and the 240 m level of the North 'A' Zone. The Bell West Zone, discovered at the end of 1989, was mined out between the 60 and 180 m levels. However, there is still potential for additional gold mineralization in this zone. All mining was done by blasthole methods at the Bell Creek Mine.

At the Marlhill Zone to the north, access to the ore was by a decline. The 150 m level is the lowest level, however, all stope production came from above the 100 m level. The breaking of ore at the Marlhill Zone stopped in mid-August and mucking out was completed in September.

Exploratory development at the Bell Creek Mine during 1991 included a raise driven along ore in the North 'A' Zone, west of the diabase dike, from the 240 m level to the 180 m level and exploratory drifting along the North 'A' Vein on the 180 m level west, of the dike. A raise was also driven from the 180 m level to the 120 m level on the Bell West Zone.

A narrow, high grade northeast-striking quartz zone extending from the Bell West Zone was discovered in 1991. Drifting along the vein was done on the 120 m level and a few lifts were taken on the vein. Potential still exists in all directions to extend the zone.

Exploration drifting was done on the projected extension of the vein structure at the Marlhill Zone on the 150 m level.

Underground diamond drilling, completed in 1991 along extensions of the producing vein structures, provided encouragement for possible further development and exploration (Canamax Resources Inc., personal communication, 1991; L.E. Luhta, personal observation, 1991).

FALCONBRIDGE GOLD CORPORATION, HOYLE POND MINE

Production at the Hoyle Pond Mine for 1991 was 100 196 t at a grade of 18.54 g/t Au. Ore was processed on a custom milling basis at Falconbridge Limited's, Kidd Creek Division

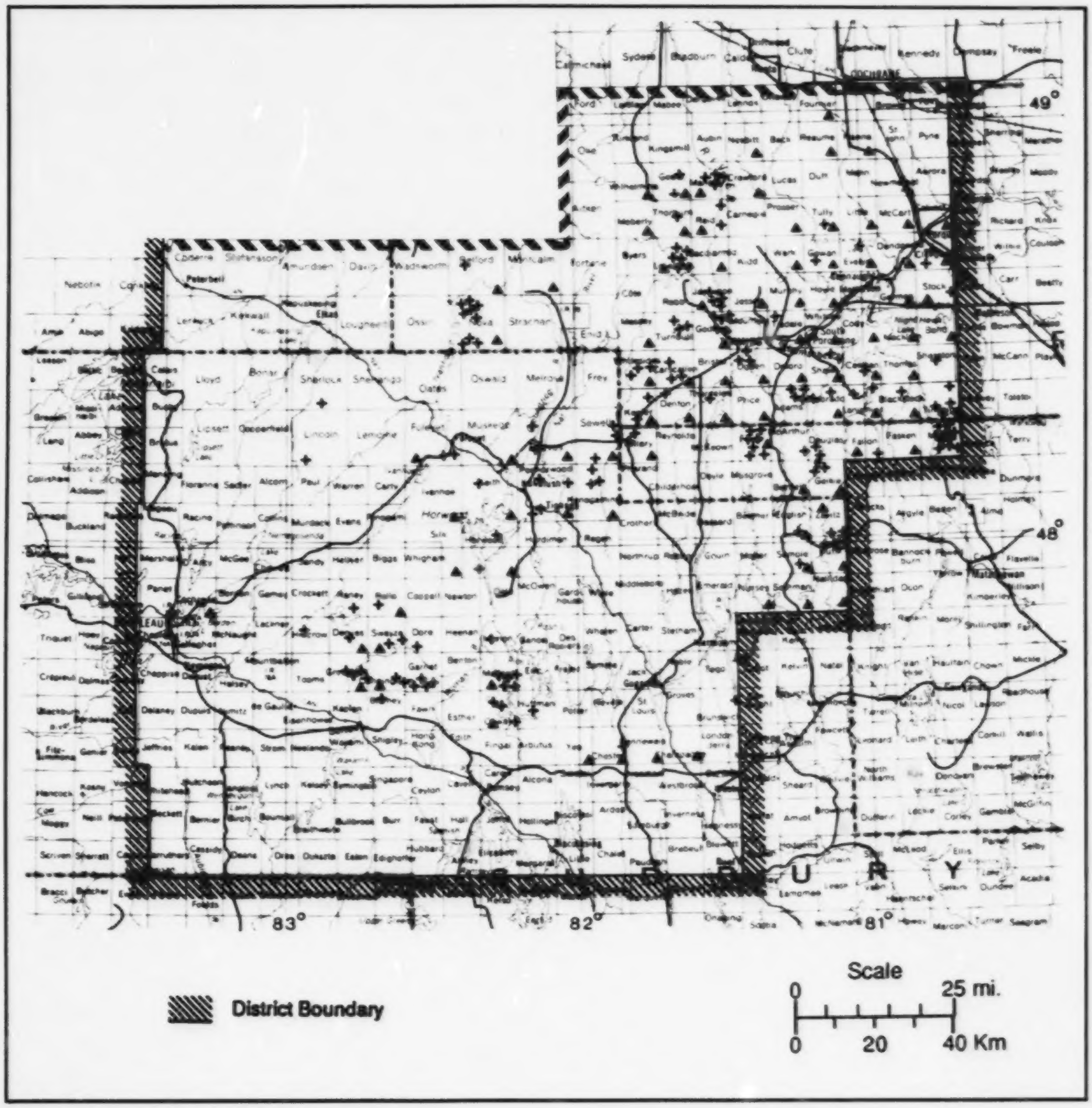

49°
48°
83°
82°
81°
COCHRANE
S U D B U R Y
District Boundary
Scale
0
25 mi.
0
20
40 Km

Figure 13.1e Timmins Resident Geologist's District.

LEGEND

Timmins Resident Geologist's District

▲ Township for which assessment received 1991

+ Claims staked, 1991 (approx. 1 '+' per 20 claims) gold milling facility. Beginning in January, 1992, the ore will be milled at the Bell Creek mill which was purchased at the end of 1991 by Falconbridge Gold Corporation.

Total ore mined to the end of December, 1991, at the Hoyle Pond Mine was 670 000 t at an average grade of 18.41 g/t Au. Reserves remaining at the end of December, 1991, are 271 343 t grading 16.5 g/t Au.

The Hoyle Pond deposit is accessed via a ramp and at the end of 1991, the bottom was at 295 m below surface. The lowest mining level was 280 m below surface. Five gold-bearing quartz veins are being mined, of which the No. 16 vein is the most prolific. This vein occurs in a flow top breccia with graphite and is linear and parallel to stratigraphy. All other veins are irregular, crosscutting fracture fills. The No. 16 vein appears to be pinching out at 280 m below surface.

At any one time, 14 cut and fill stopes are being mined. Smelter slag has recently been introduced as backfill material. One small longhole stope is being developed on the No. 10 vein.

Underground exploratory drilling at Hoyle Pond included attempting to extend the No. 16 vein to depth and to the north. A new vein, the No. 19 vein, was discovered north of the No. 16 vein between it and the sedimentary contact. Six holes were diamond drilled into the structure with a few scattered gold values obtained. No immediate follow-up work on this vein is planned for 1992. Surface diamond drilling was done as follow-up to a 1990 drill program which intersected gold mineralization 600 m south and 200 m vertically down from the mine workings, at the south side of a komatiite body in contact with tholeiitic basalts. Called the South Zone, gold mineralization occurs in quartz veins and in disseminated sulphides along the komatiite-tholeiite contact. It is reported to be very similar to the Bell Creek West Zone at the Bell Creek Mine. A few diamond-drill holes are to be drilled in this area in 1992 (Falconbridge Gold Corporation, personal communication, 1991; L.E. Luhta, personal observations, 1991).

PLACER DOME INC., DETOUR LAKE MINE

In 1991, the Detour Lake Mine recovered 119 000 ounces of gold from the milling of 798 000 t of ore at an average grade of 4.9 g/t Au.

Sixty percent of the ore came from the Main Zone, a silicified (cherty) zone along the contact between komatiitic and tholeiitic rocks, using mechanized cut and fill mining methods. Forty percent of the ore came from quartz stockworks in tholeiitic rocks mined by blasthole techniques.

In the Main Zone, mining of the last lift took place on the 200 m level in 1991. No ore remains above except for the crown pillar. Mining of the last lift on the 300 m sublevel in the main zone was also taking place in 1991. A sill pillar is to be left. Mining is being conducted on the 430 m sublevel and has begun on the 560 m level (the bottom level).

Ramping has taken place below the bottom level down to the 660 m level, since the shaft only extends to 590 m. A hanging wall drift was developed and definition drilling was done to outline ore in the Main Zone at that elevation. Mining will commence here in early 1992. Loss of production from the Main Zone on the 200 m and 300 m levels is being replaced by production on the 560 m and 660 m levels.

Underground exploration drilling in 1991 consisted of outlining ore below 660 m and to the west.

Under contract with Placer Dome Exploration, extensive surface exploration was done on the mine property including the recutting of 380 km of line, providing coverage for the entire property. Extensive ground geophysical surveys including 280 km of magnetometer surveys and 110 km of IP surveys were completed. Reconnaissance geological mapping from the west end of the mine to the west boundary of the property and surface diamond drilling were in progress at the end of 1991. The first phase of drilling, completed on November 8, 1991, totalled 1584 m in 8 holes. The program was designed to explore the mine horizon from the west end of the mine to the west end of the property (Placer Dome Inc., Detour Lake Mine, Placer Dome Exploration, personal communication, 1991).

PLACER DOME INC., DOME MINE

In 1991, the Dome Mine in Tisdale Township recovered 144 765 ounces of gold from 1 267 200 tons of ore at an average grade of 0.119 ounce Au per ton with a mill recovery of 96%. The open pit produced approximately 25% of the tonnage. The average underground grade was 0.136 ounce Au per ton and the average pit grade was 0.085 ounce Au per ton.

Since the strike in 1990, the Dome Mine has been undergoing a renewal plan to cut costs. Manpower has been reduced by 50% since the strike. Changes in operating plans are being made to produce the same tonnage but at higher grades. One example includes sampling which is now being done by the geology department at the same time as mapping for better grade control. Longhole mining is being increased from 45% to 60% of the total underground method of production. The Dome is also developing some lower cost shrinkage stopes as opposed to cut and fill stopes.

The bottom production level at the mine is 29 level which is 4000 feet below surface. A longhole stope is being developed on the 32 level (4600 feet below surface). The bulk of the underground production comes from above the 26 level (3500 feet below surface).

Most underground exploration is taking place on the lower levels in an attempt to outline deeper extensions of ore in the Preston porphyry and within the sedimentary trough. Other gold zones in the upper levels are being evaluated for their longhole mining potential.

A large, surface diamond-drill program took place to delineate additional ore around the open pit. A feasibility study is being done on mining a "super pit" which might include moving some of the mine's surface infrastructure.

Under contract with Placer Dome Exploration, surface mapping, trenching and stripping was done a few hundred metres north and east of the Dome Mine's No. 8 shaft. Eighteen surface diamond-drill holes totalling 1810 m were completed. A potential open pit zone containing at least 50 000 tons was outlined (Placer Dome Inc., Dome Mine, Placer Dome Exploration, personal communication, 1991).

ROYAL OAK MINES INC., TIMMINS OPERATIONS

On July 22, 1991, Royal Oak Mines Inc. was formed through the amalgamation of Royal Oak Resources Ltd., Giant Yellowknife Mines Ltd., Pamour Inc., Pamorex Minerals Inc., and Akaitcho Yellowknife Gold Mines Ltd. Royal Oak Mines Inc. now has direct ownership of all the Timmins operations formerly controlled by Giant Yellowknife Mines Ltd.

In 1991, the total production from the Timmins operations was 1 219 962 tons at an average grade of 0.084 ounce Au per ton.

Production from the Timmins operations centred around the Pamour No. 1 mine site where ore was mined from the Pamour No. 1 underground mine, the Hoyle underground mine, the No. 5 pit adjacent to the Broulan boundary to the west, and the No. 3 pit adjacent to the No. 1 Mine.

Ore produced from the Hoyle Mine by bulk mining methods is conveyed along the 1400 foot level to the Pamour No.1 Mine's No.3 shaft where it is skipped to surface.

Underground exploration was successful in outlining narrow, high-grade ore between 1800 and 2000 feet below surface in the TN Vein System. This system is located within the greywackes in the north part of Pamour No. 1 Mine. The limits of 51 Vein, between 1400 and 1800 feet below surface in the volcanic rocks and also within the north part of the No. 1 Mine, were expanded to the east and at depth. These narrow, high-grade veins contribute 5% of the total mined tonnage at the No. 1 Mine (Royal Oak Mines Inc., personal communication, 1991).

ST. ANDREW GOLDFIELDS LTD.

In 1991, the Stock Township underground mine of St. Andrew Goldfields Ltd. mined and milled 142 698 tons at an average grade of 0.151 ounce Au per ton. During July and August, the mine reduced underground mining operations, however, the mill was kept at capacity (550 tons per day) by milling ore from the Hislop Mine of Goldpost Resources Ltd. and stockpiled ore on surface.

Over 60% of the production for the Stock Township Mine came from the N-2 Zone, a felsic body containing disseminated pyrite within a carbonated ultramafic. Included in this tonnage is a small amount of ore from 3 satellite zones, 200 to 400 m west and along strike of the N-2 Zone. These are small felsic bodies (islands) not connected to the N-2 Zone or to each other, with gold mineralization along their contacts with the carbonated ultramafics. In these satellite zones, the porphyry bodies themselves are barren. Included also with the tonnage of the N-2 Zone is almost 30 000 tons of ore from a zone 50 feet south of the N-2 Zone between the 4th and 5th levels. This zone was discovered while mining the N-2 Zone and consists of narrow quartz-carbonate veinlets with 2% disseminated pyrite in carbonated ultramafic rocks. All mining in the N-2 and associated zones was by cut and fill methods. Classified mill tailings with sand from a pit in Taylor Township is slurried into the stopes as fill along with all mine development waste rock.

The remaining ore from the Stock Township Mine came from the longhole mining of the M-1 Zone, a gold-bearing zone in carbonated and sericitic tholeiitic rocks with fine quartz stringers and disseminated pyrite.

The bottom of the shaft at the Stock Township Mine is at 880 feet below surface, however, the bottom level at the mine is the 4th level, 575 feet below surface. Due to ground problems (swelling and caving of the talc chlorite schist in the shaft), the shaft is not used below the fourth level. A ramp has been driven down to the 6th level (-850 feet) and is proceeding to the 7th level (-1000 feet). Mining the N-2 Zone is proceeding with 2 stopes on the 5th (-725 feet) level and 2 stopes on the 6th level.

Underground exploration consisted of drilling 10 diamond-drill holes in early 1991 to trace the western extension of the N-2 Zone above and below the 6th level.

A fork off the ramp will be made and a drive westward towards the West Zone will be developed on the 7th level. This zone was found by a surface drill program in a joint venture with Esso Resources in 1987-88 and is thought to be on the westward down-plunge extension of the M-1 Zone.

A total of 85 000 tons of ore grading 0.195 ounce Au per ton from the Goldpost Resources Inc. Hislop East property were milled at the St. Andrew's Stock Township mill (St. Andrew Goldfields Ltd., personal communication, 1991; L.E. Luhta, personal observation, 1991).

Industrial Minerals

LUZENAC INCORPORATED, REEVES MINE

Production of talc from the Penhorwood Township open pit mine began in 1978 by Steetley Talc Incorporated. In 1988, Luzenac Incorporated purchased the Steetley operations. Talc is obtained from the mining and beneficiation of a talc-magnesite altered komatiite. Mining is done in January and February with the ore being stockpiled. Beneficiation is done throughout the year. The talc is concentrated at the mine site and processed at a fine-grind plant in Timmins. Most of the talc is sold to the pulp and paper industry in North America with some sold to the paint and plastics industry.

In 1991, the company produced and marketed 38 000 tons of talc from 113 000 tons of ore mined and milled, the same as that produced in 1990. However, at the end of 1991, talc production was down due to poor market conditions, resulting in temporary layoffs. This is attributed to the recession and poor market conditions for their major customer—the pulp and paper industry. At present capacity, proven ore reserves are good for another 10 years of production.

Luzenac Incorporated operates two other talc operations in North America. A small processing plant in Canfield, Ohio, which obtains its ore from China and a small mining and milling operations in Broughton, Quebec.

The company is investigating the production of another product of different grind in Timmins in order to establish new markets. This will involve adding additional processing equipment to their fine-grind plant in Timmins.

In 1991, 50 people were employed at Luzenac Incorporated's Timmins operations, the same as in 1990 (Luzenac Incorporated, personal communication, 1991).

ADVANCED EXPLORATION AND DEVELOPMENT

Placer Dome Inc., American Reserve Mining Corporation, Paymaster Project

A program to access possible gold ore below the 5500 foot level of the former Paymaster Mine was initiated in 1989 by the joint venture partners Placer Dome Inc. (60% interest) and American Reserve Mining Corporation (40% interest).

The project included constructing a headframe, pumping out the mine to the 6025 foot level and rehabilitating the No. 5 shaft to its bottom depth of 4375 feet below surface. A hoist was erected at the collar of the No. 6 shaft (4075 foot level), and the internal shaft was rehabilitated to the bottom level, 6025 feet below surface.

Total underground development, confined to the 6025 foot level, totalled 1595 feet, and consisted of 780 feet of crosscutting and 815 feet of drifting (including a 346 foot by-pass drift). Underground diamond drilling totalled 16493 feet.

Two gold-bearing quartz vein zones have been outlined, the 36 and 37 zones. Both dip steeply north with the main zone, the 36 Vein being in the footwall (south side) and the 37 Vein being in the hanging wall (north side). Diamond drilling was done from the 6025 foot level and from a drill bay at the end of a crosscut driven north from that level, to trace the mineralized zones 750 feet below the level. The two zones come together in places and in other places are up to 200 feet apart. The strike length of the 36 Vein is at least 800 feet and the strike length of 37 Vein is currently unknown. Approximately $14 million has been spent on the project. The mine, at the end of 1991, was on a care and maintenance basis. American Reserve Mining reported that they have calculated a reserve figure of over a half-million tons grading 0.33 ounce gold per ton between 6000 and 6600 feet below surface. Ore reserve calculations and a feasibility study is to be completed by Placer Dome Inc. in early 1992 (Placer Dome Inc., personal communication, 1991).

Claude Rundle Gold Mines Limited, Claude Rundle Mine

Claude Rundle Gold Mines Limited, a private company, is reportedly developing the Rundle Mine property in Newton Township. Although the company has not yet released any information on the current program, a certain amount of data on the property is available from past development projects and from personal observations made by the Resident Geologist.

The Rundle Mine is an Archean lode gold deposit consisting of fracture controlled gold mineralization in felsic intrusive and mafic volcanic rocks. There is no record of gold production from the deposit which was originally discovered in 1940 by Claude Rundle, an employee of Hollinger Gold Mines Ltd.

In 1941, Hollinger sunk a shaft and completed underground development on the property. Proven and probable reserves were 91 000 t at 9.49 g/t Au when operations were suspended due to wartime conditions. In 1981, Sulpetro Minerals Ltd. completed an access road to the mine and continued to explore the deposit until 1986 when they were succeed by Novamin Resources. Novamin actively explored the property from 1986 to 1987 and updated ore reserves of 500 000 t at 7 g/t Au were published at the conclusion of their surface program. Further underground exploration by Novamin resulted in revised reserves of 534 820 tonnes at 6.53 g/t Au.

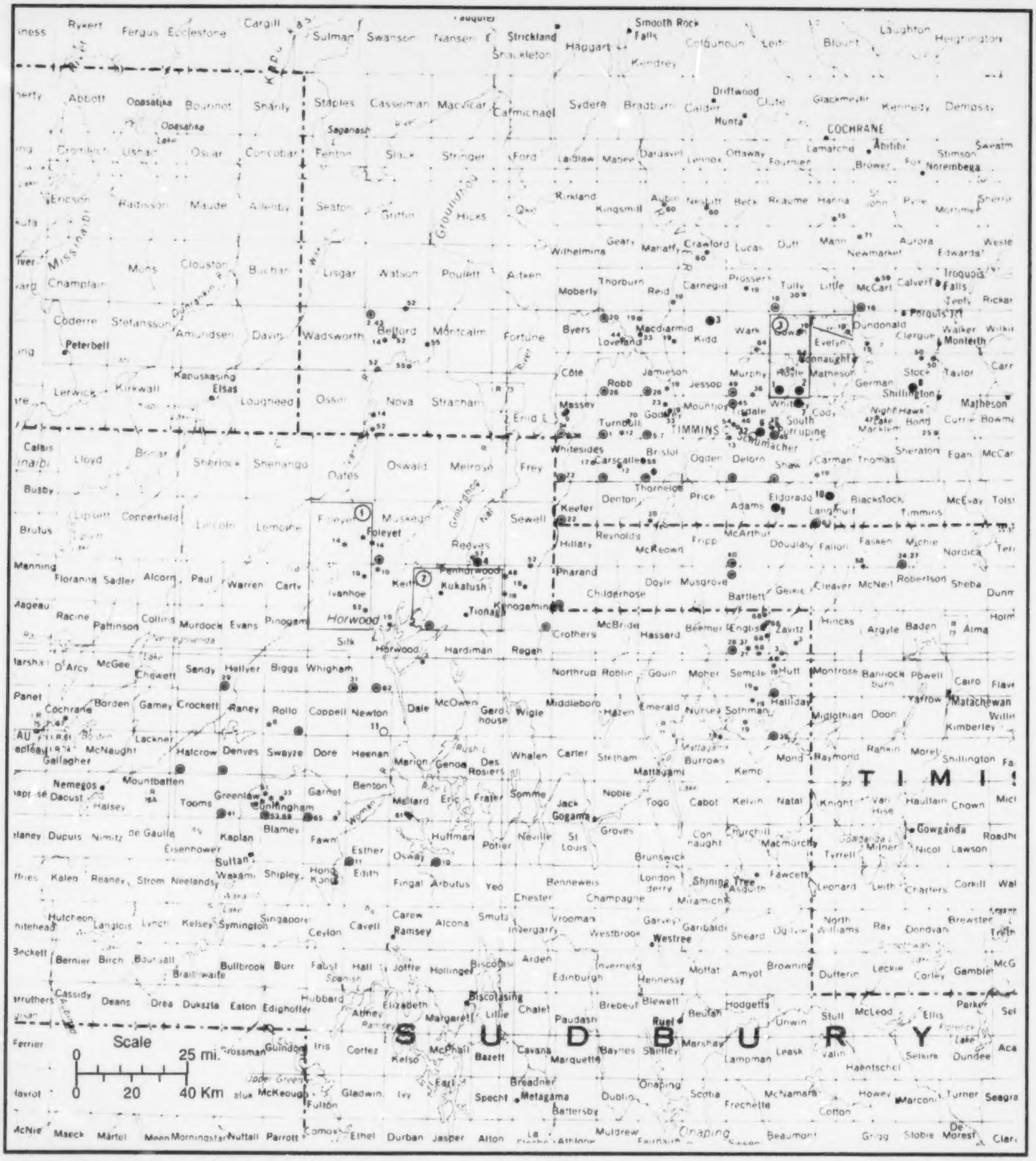
In 1991, the current owner acquired the property. Although no details of activties have been released, it is known that the company has upgraded the road to the mine site and has completed extensive mapping, stripping and surface rock sampling (Resident Geologist Office Files; L.E. Luhta, personal observation, 1991).

EXPLORATION ACTIVITY

There was a general decrease in exploration activity from 1990 levels. Although claim staking increased marginally, the bulk of assessment data received during 1991 was from work completed several years ago.

Many companies concentrated their efforts on the compilation of existing data rather than on field work. A survey of exploration companies in the area indicated that close to 60 exploration geologists were laid off during the year.

Exploration work completed during the year was done mainly by major companies and by locally based independent prospectors and consultants. Highlights from the year's exploration activity are given below. For a detailed summary of all exploration in the district, please refer to Table 13.3 and Figure 13.2.


Smooth Rock Falls
Strickland
Shackleton
Haggart
Driftwood
Hunta
COCHRANE
Abitibi
Norembega
Calder
Clute
Kennedy
Dempsay
Carmichael
Sydere
Bradburn
Staples
Casselman
Macvicar
Abbott
Opasatika
Bourinot
Shanly
Saganash
Fenton
Stringer
Ford
Laidlaw
Mabee
Lennox
Ottaway
Fournier
Lamarche
Brower
Stimson
Ericson
Radisson
Maude
Allenby
Seaton
Griffin
Hicks
Kirkland
Kingsmill
Aubin
Nesbitt
Beck
Beaume
Hanna
Wilhelmina
Geary
Mahaffy
Crawford
Lucas
Duff
Newmarket
Aurora
Edwards
Mons
Clouston
Buchan
Lisgar
Watson
Poulett
Aitken
Moberly
Thorburn
Reid
Carnegie
Prosser
Tully
Little
McCart
Calvert
Iroquois Falls
Champlain
Coderre
Stefansson
Amundsen
Davin
Wadsworth
Belford
Montcalm
Fortune
Byers
Loveland
Macdiarmid
Kidd
Wark
Gowan
Evelyn
Dundonald
Clergue
Walker
Monteith
Peterbell
Côte
Jamieson
Murphy
Connaught
Hoyle
Matheson
Stock
Taylor
Lerwick
Kirkwall
Kapuskasing
Elsas
Loughheed
Ossin
Nova
Strachan
Robb
Jessop
Mountjoy
Whitney
German
Shillington
Matheson
Massey
Turnbull
Godfrey
TIMMINS
Tisdale
South Porcupine
Cody
Night Hawk Lake
Bond
Currie
Bowman
Whitesides
Bristol
Ogden
Deloro
Shaw
Carman
Thomas
Sheraton
Egan
Lloyd
Bonar
Sherlock
Shenango
Oates
Oswald
Melrose
Frey
Carscallen
Thorneloe
Denton
Price
Adams
Eldorado
Langmuir
Blackstock
Timmins
McEvay
Busby
Lipsett
Copperfield
Lincoln
Lemoine
Foleyet
Muskego
Sewell
Keefer
Reynolds
McKeown
Fripp
McArthur
Douglas
Fallon
Fasken
Michie
Nordica
Brutus
Reeves
Hillary
Manning
Floranna
Sadler
Alcorn
Paul
Warren
Carty
Ivanhoe
Keith
Penhorwood
Kukatush
Pharand
Doyle
Musgrove
Cleaver
McNeil
Robertson
Sheba
Racine
Pattinson
Collins
Murdock
Evans
Pinogami
Horwood
Tionaga
Chappais
Childerhose
Bartlett
Geikie
Hincks
Argyle
Baden
Alma
Silk
Hardiman
Regan
Crothers
McBride
Hassard
Beemer
English
Zavitz
D'Arcy
McGee
Chewett
Sandy
Hellyer
Biggs
Whigham
Northrup
Roblin
Gouin
Moher
Semple
Hutt
Montrose
Bannockburn
Powell
Cairo
Panet
Cochrane
Borden
Gamey
Crockett
Raney
Rollo
Coppell
Newton
Dale
McOwen
Gardhouse
Wigle
Middleboro
Hazen
Emerald
Nursey
Sothman
Halliday
Midlothian
Doon
Yarrow
Matachewan
Kimberley
Lackner
McNaught
Halcrow
Denyes
Swayze
Dore
Heenan
Marion
Genoa
Des Rosiers
Whalen
Carter
Stetham
Burrows
Mattagami
Kemp
Mond
Raymond
Rankin
Morel
Shillington
Gallagher
Nemegos
Mountbatten
Daoust
Halsey
Tooms
Greenlaw
Cunningham
Garnet
Benton
Mallard
Eric
Fraleck
Somme
Jack
Noble
Togo
Cabot
Kelvin
Natal
Knight
Van Hise
Haultain
Chown
TIMMINS
Dupuis
Nimitz
de Gaulle
Eisenhower
Kaplan
Blamey
Fawn
Esther
Huffman
Potier
Neville
St Louis
Groves
Gogama
Brunswick
Connaught
Churchill
Macmurchy
Tyrrell
Milner
Gowganda
Nicol
Lawson
Sultana
Kalen
Reaney
Strom
Neelands
Wakami
Shipley
Hong Kong
Oswald
Edith
Fingal
Arbutus
Yeo
Bennewies
Chester
Champagne
Londonderry
Shining Tree
Asquith
Miramichi
Fawcett
Leonard
Leith
Charters
Corkill
Hutcheon
Langlois
Lynch
Kelsey
Symington
Singapore
Ceylon
Cavell
Carew
Ramsey
Alcona
Smuts
Invergarry
Vrooman
Westbrook
Garvey
Westree
Garibaldi
Sheard
Ogilvie
North Williams
Ray
Donovan
Brewster
Beckett
Bernier
Birch
Boursall
Braithwaite
Bullbrook
Burr
Faust
Hall
Joffre
Hollinger
Biscotasi
Arden
Edinburgh
Inverness
Hennessy
Moffat
Amyot
Browning
Dufferin
Leckie
Corley
Gamble
Cassidy
Deans
Drea
Dukszta
Eaton
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Hubbard
Athey
Elizabeth
Margaret
Biscotasing
Lillie
Chalet
Paudash
Brebeuf
Blewett
Ruel
Beulah
Hodgetts
Unwin
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Parker
Ferrier
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Grossman
Guindon
Iris
Cortez
Kelso
McPhail
Bazett
Cavana
Marquette
Baynes
Stanley
Marshay
Lampman
Leask
Valin
Selkirk
Dundee
SUDBURY
Haentschel
Earl
Breadner
Metagama
Specht
Dublin
Onaping
Scotia
Frechette
McNamara
Cotton
Howey
Marconi
Turner
Seagram
Gladwin
Ivy
Fulton
McKeough
Battersby
McNie
Maeck
Martel
Moen
Morningstar
Nuttall
Parrott
Comox
Ethel
Durban
Jasper
Alton
Athlone
Muldrew
Fairbairn
Onaping
Beaumont
Grigg
Stobie
De Morest
Clary

Figure 13.2. Timmins Resident Geologist's District. Exploration activity, 1991.

LEGEND

Timmins Resident Geologist's District

2★ Exploration activity, 1991
(keyed to Table 13.3)

⊛ Township where 1991 OPAP funded project in progress

◆ Property examinations, 1991

2● Producing Mine, 1991

1.	Canamax Resources, Bell Creek Mine	Au
2.	Falconbridge Gold Corp., Hoyle Pond Mine	Au
3.	Falconbridge Limited, Kidd Creek Mine	Cu, Zn, Ag, Pb, Cd, Sn, In
4.	Luzenac Incorporated, Reeves Mine	talc
5.	Placer Dome Inc., Detour Lake Mine	Au
6.	Placer Dome Inc., Dome Mine	Au
7.	Royal Oak Mines Inc., Timmins Operations	Au
8.	St. Andrew Goldfields Ltd.	Au
9.	Timmins Nickel Inc., Redstone Mine	Ni
10.	Timmins Nickel Inc., Langmuir No. 1	Ni

2○ Advanced Exploration and Development Project, 1991

11.	Claude Rundle Mine	Au
12.	Placer Dome Inc.—American Reserve Mining Corp., Paymaster Project	Au

② Location of OGS Field Party in 1991

1. Geology of Foleyet and Ivanhoe Townships, northern Swayze Greenstone Belt
2. Eastward Tracing of the Patricia Showing–Hoodoo Prospect Deformation Zone
3. Geology of Hoyle and Gowan Townships

Table 13.3. Exploration activity during 1991, Timmins Resident Geologist's District.

Abbreviations

AEM	Airborne electromagnetic survey	VLF	Very low frequency electromagnetic survey
AMag	Airborne magnetometer survey	py	pyrite
ARad	Airborne radiometric survey	cpy	chalcopyrite
HLEM	Horizontal loop electromagnetic survey	sph	sphalerite
VLEM	Vertical loop electromagnetic survey	po	pyrrhotite
Mag	Magnetometer survey	asp	arsenopyrite
GC	Geochemical survey	ga	galena
DD	Diamond drilling	mag	magnetite
IP	Induced polarization survey	gf	graphite

Company or Individual Location	Activity	Remarks
1. S. Anderson, Turnbull Township	exploration	information supplied by OPAP
2. T. Anderson, Belford Township	exploration	information supplied by OPAP
3. Asarco Exploration Co. of Canada Ltd.	DD-6-1011m	base metal exploration
Horwood Township		(Ross, Morin, Denommee option relinquished)
Zavitz Township	DD-2	to test EM anomalies
Hutt, Zavitz, Nova, Montcalm townships	line cutting	follow-up to OGS AEM release
Garnet Township	geology, geophysics	former Mingold Fawn Creek Property, gold exploration
4. BHP Utah Mines Ltd., Hutt Township	geology, GC	base metal exploration, follow-up to 1990 program
5. R. Bald, Godfrey Township	exploration	information supplied by OPAP
6. G. Beith property, Hong Kong Township	sampling	leased claim anomalous Au, Cu, Pb, Ni noted
7. P. Bilenki, Godfrey Township	exploration	information supplied by OPAP
8. Black Gregor Exploration-Carlson Mines Ltd. Rollo Township	stripping, trenching	Cyril Knight gold occurrence, program began in 1986
9. J. Boissoneault property, Massey Township	geology, HLEM, stripping	*see* "Property Examinations", this volume
10. W. Brereton, Huffman Township	exploration	information supplied by OPAP
11. M.L. Burton, Esther Township	exploration	information supplied by OPAP
12. Cambior Resources Inc. Carscallen, Turnbull townships	geology	results of mapping currently being assessed
13. Cogema Canada Limited, Tisdale Township	geology, sampling	Moneta Mines Kayorum property gold exploration
14. Cominco Limited	Mag, HLEM	base metals exploration
Foleyet Township		one conductor located
Foleyet, Muskego townships	Mag, HLEM, humus GC	
Nova Township (Meander Grid)	Mag, HLEM, humus GC	base metals exploration, follow-up to airborne survey two conductors located
Belford Township (Komak Grid)	Mag, HLEM, humus GC	base metals exploration, follow-up to airborne survey five conductors located
Cunningham Township	DD	base metals exploration
15. Comstate Resources, Hanna Township	Mag, HLEM	follow-up to 1989 program, gold & base metal exploration
16. K. Cunnison McCart Township	exploration	information supplied by OPAP
17. A. Dea Property Whitesides Township	Mag, VLF	further geological mapping and surveys planned
18. C. Desson, Tully Township	exploration	information supplied by OPAP
19. Falconbridge Ltd.	DD-3-1108m	base metals exploration
Macdiarmid, Loveland townships		
Prosser Township	Mag, EM	gold or base metals exploration, 2 weak targets outlined
Keith, Ivanhoe townships	Mag, HLEM, line cutting	gold or base metals exploration, several targets outlined
Carman Township	Mag, HLEM	base metals exploration 1 bedrock conductor outlined follow-up to work done 1989–90
Cunningham Township	HLEM	base metals exploration several anomalies outlined
Reid, Macdiarmid	DD-1 288 m	base metals exploration
	DD-1 308 m	py noted
Semple Township	DD-1 393 m	to test Mag and HLEM anomalies, base metals exploration, py, sph noted
Hutt Township	DD-1 345 m	to test Mag and HLEM anomalies, base metals exploration, py noted
Sothman, Halliday townships	DD-4 1660 m	to test Mag and HEM anomalies py, po, sph, cpy, ga noted
Nursey Township	DD-1 416 m	
Penhorwood, Kenogaming townships	Mag, HLEM	6 bedrock conductors detected, further work recommended

Table 13.3. Continued.

	Company or Individual Location	Activity	Remarks
	Evelyn, Dundonald	AMag, AVLF, ARad	base metals exploration
	Little Townships	DD-4 1288 m	275 km^2 flown
	Godfrey Township	Mag, HLEM	gold and base metals exploration, 1 strong conductor outlined
	Penhorwood, Kenogaming townships	Mag, HLEM	continuation of 1990 surveys, no new anomalies detected
	Jamieson Township	DD-2 550	base metal exploration, po, cpy, py, mag, asp noted
	Gowan Township	DD-1-276m	follow-up to 1990
		DD-5 1422 m	geophysics, py, po, cpy, sph noted
20.	D. Fenato, Loveland Township	exploration	information supplied by OPAP
21.	GRQ Syndicate, English Township	DD-2 800 feet	to test EM conductor coincident with Mag anomaly data from Granges Exploration 1970's airborne survey
22.	F. Galata, Sr., Keefer Township	exploration	information supplied by OPAP
23.	W. Gasteiger Property, Godfrey Township	Mag, HLEM	base metal exploration, 2 conductors outlined
24.	L.Gervais, S. Mortson, Michie Township	AEM	information supplied by OPAP
25.	Granges Exploration AB, Bond Township	Mag, HLEM	follow-up to OGS AEM Survey, 3 conductors outlined
26.	J.C. Grant and Y. Collin Robb, Jamieson Townships	exploration	information supplied by OPAP
27.	M. Guiho, Michie Township	exploration	information supplied by OPAP
28.	P.G. Harvey, English Township	exploration	information supplied by OPAP
29.	R.G. Hodgson, Hellyer Township	exploration	information supplied by OPAP
30.	Homestake Mineral Development Limited Tully Township	DD-2 372 m	follow-up to 1990 surveys, po, py, cpy, sph noted, best assay 346 ppb Au
	Denton, Thornloe Townships	DD-1	gold exploration
31.	R. Jarvi, Silk Township	exploration	information supplied by OPAP
32.	D.V. Jones property, Whitney Township	VLF	3 weak anomalies defined, further work recommended
33.	Kirkton Resources Cunningham Township	trenching, sampling	Shunsby Property, Cu, Pb, Zn, *see* "Exploration Activity" this volume
34.	D. Laforest, Massey Township	exploration	information supplied by OPAP
35.	J.R. Lill property, Pearce Township	DD-1 463 feet	REE assays reported, *see* "Property Examinations", this volume
36.	D. Londry property, Murphy Township	Mag, HLEM,VLF	1 bedrock conductor identified, IP survey recommended
37.	E.H. Ludwig, English Township	exploration	information supplied by OPAP
38.	C.D. Mackenzie, Whitesides Township	exploration	information supplied by OPAP
39.	G. McBride, Halliday Township	exploration	information supplied by OPAP
40.	N. McBride, McArthur Township	exploration	information supplied by OPAP
41.	B. McDonough, K. McDonough Greenlaw Township	exploration	information supplied by OPAP
42.	Mckinnon Prospecting Mulloy, Auden, Shuel, Rowlandson townships	AMag, AEM, AVLF	2550 km^2 covered, *see* "Exploration" this volume, gold exploration
	Limestone Rapids, Fox River, Feagan Lake, Pitopiko River Areas, Hurdman Township	AMag, AVLF, AEM	
43.	R. Meikle, Belford Township	exploration	information supplied by OPAP
44.	D. Meunier and G. Sutherland property Loveland Township	geology	grid re-established ground geophysical surveys
45.	P.R. Meunier Whitney, Tisdale townships	exploration	information supplied by OPAP
46.	Moneta Porcupine, Tisdale Township	Mag, Vlf	weak anomalies defined, IP surveys recommended
	Godfrey Township	8 mi^2 staked	gold exploration
	Loveland Township	16 mi^2 staked	base metal exploration
47.	E. Mord property	Macklem Township	Mag,VLF follow-up to geology
48.	D. Morin property, Rollo Township	stripping	
	Kenogaming Township	DD-6 629 m	follow-up to 1989-90 program, Ni, Cu values reported
49.	D. Mullen, Murphy Township	exploration	information supplied by OPAP
50.	Nahanni Mines, Stock Township	Mag, VLF	gold exploration
		DD-7 1050	sulphide zones reported
51.	Noble Peak Resources Cunningham Township	optioned	Cu, Zn exploration, Isiah Creek

Table 13.3. Continued.

Company or Individual Location	Activity	Remarks
52. Noranda Exploration Company Limited Nova, Ivanhoe, Watson, Belford townships	Mag, HLEM	follow-up to OGS airborne survey, gold and base metal exploration, *see* "Exploration Activity", this volume
Kenogaming, Sewell townships	Mag	
53. B. Otten, Cunningham Township	exploration	information supplied by OPAP
54. Pamorex (Royal Oak Resources) Tisdale Township	DD-4 5500 feet	gold exploration, Pearl Lake
55. Placer Dome Inc. W. Sunday Lake, Hopper Lake, Lower Detour areas	Mag	*see* "Mining Activity", this volume
Belford, Montcalm townships	Mag, HLEM	*see* "Exploration", this volume
56. R. Poirier property, Bristol Township	geology	no outcrop, geophysics planned, gold exploration
57. D.R. Pyke and B. Raine property Reeves Township	Mag, VLF	gold exploration
58. Queenston Mining Inc., Fasken Township	AEM, AMag, AVLF	gold and base metal exploration
59. B. Raine property, McCart Township	VLF	nickel exploration
60. Rio Algom Exploration Inc. Nesbitt, Crawford, Aubin townships	DD-7 1200 m, OVD-229, assays	gold and base metal exploration
61. Ross-Morin property, Mallard Township		gold exploration, *see* "Property Examinations" this volume
62. G. Ross, F. Ross, D. Morin, R. Denommee Horwood Township	exploration	information supplied by OPAP
63. R. Rousseau, Langmuir Township	exploration	information supplied by OPAP
64. A.J. Salo property, Hoyle Township	DD-2 179 m	testing Mag anomaly
Wark Township	DD-1 180 m	base metal "stringers" noted
65. L. Salo, Garnet Township	exploration	information supplied by OPAP
66. Tintina Mines Ltd., English, Zavitz townships	Mag	*see* "Property Examinations", this volume
67. M.A. Tremblay property, Cochrane Township	VLF	soil geochem, stripping planned
Casselman Township	GC	gold and zinc anomalies noted
68. Tri Origin Exploration Ltd. English, Semple townships	Mag, VLF	gold, copper, zinc prospecting exploration, anomalous Au values reported
69. W. Troup, Cunningham Township	exploration	information supplied by OPAP
70. Turnbull Syndicate, Turnbull Township	stripping, mapping, sampling	gold and base metal exploration, Dipaolo property, anomalous Cu, Zn, Au, Ag values
71. J.T. Ward, Newmarket Township	Mag, VLEM, GC	gold and base metal exploration
72. D. Warren, Whitesides Township	exploration	information supplied by OPAP

Noranda Exploration Company, Limited

During 1991, Noranda Exploration Company, Limited remained one of the most active companies in the district.

Gold exploration included the Porcupine West Project in Sewell and Reeves townships. Line cutting, ground geophysical surveys, mapping and trenching established diamond-drill targets for drilling planned for 1992.

The company also maintained active exploration for base metals in several areas.

In the Montcalm Project area, 8 diamond-drill holes totalling 2000 m were drilled on property in Nova, Belford and Ivanhoe townships. In addition, 9 holes totalling 2000 m were diamond drilled in Cunningham Township. Line cutting and geophysical surveys were completed in Foleyet Township. Further work on all base metal properties is planned for 1992 (Noranda Exploration Company, Limited, personal communication, 1991).

Placer Dome Incorporated

During 1991, Placer Dome Inc. continued to explore for both gold and volcanogenic massive sulphide deposits in the Timmins Resident Geologist's District. The company completed line cutting, magnetometer and horizontal loop electromagnetometer surveys over six claim groups in Montcalm and Belford townships. These were staked following the release of Ontario Geological Survey airborne geophysical maps of the area in 1990. On the Belford North Group, 6 diamond-drill holes totalling 1342 m were completed. On the Belford South Group, 3 diamond-drill holes totalling 601 m were drilled to test electromagnetic anomalies. Most of the drill holes reportedly intersected barren sulphides (pyrite and pyrrhotite).

The company also completed geophysical surveys and diamond drilling on the following four properties in the Detour Lake area:

Property	Geophysics	Diamond Drilling
Hopper Creek	18 km Induced Polarization 80 km Magnetometer	2 holes - 271 m
Lower Detour	6 km Induced Polarization 41 km Magnetometer	2 holes - 282 m
Hopper Lake	5 km line cutting 92 km Magnetometer 14 km Induced Polarization	6 holes - 1157 m
Pelangio Larder Option	25 km line cutting 25 km Magnetometer 12 km Induced Polarization	3 holes - 306 m

(Placer Dome Inc., personal communication, 1991)

Inco Exploration and Technical Services

Inco Exploration and Technical Services had several active exploration programs in the Timmins Resident Geologist's District during 1991.

Line cutting and geological mapping of claims in Hutt Township were completed as part of a base metal exploration project. The claims were staked in 1991 as a result of the Shiningtree total intensity magnetic and electromagnetic survey release by the Ontario Geological Survey in 1990. Results thus far are reported to be positive and further work on the property is planned for 1992.

The company also staked claims on a base metal prospect in Agate Township. Grid lines are currently being established on the property and further work is planned for 1992. In addition, preliminary reconnaissance surveys have been completed in Nova, Tooms and Greenlaw townships (Inco Exploration and Technical Services Inc., personal communication, 1991).

McKinnon Prospecting

In May of 1991, Aerodat Limited, under contract to McKinnon Prospecting, completed a major helicopter-borne magnetic, electromagnetic and VLF-EM survey over a 310 km^2 area centred on Auden Township. The area covered is comprised of over 1700 unpatented claims located 20 km north and 60 km west of Hearst and is approximately 80 km long and 3 km wide running roughly parallel to Highway 11. The scope of this program and its attendant claim staking and assessment work submissions was the single factor which caused statistics in the Porcupine Mining Division to show a modest increase over 1990 exploration activity levels. The company believes that the project area contains the eastward extension of the large scale regional deformation or fault zone which hosts gold mineralization in the Beardmore–Geraldton–Longlac area.

There is very little published information on the 'Auden Project' area. Outcrop exposure is sparse and only limited diamond-drilling data is available. Previous exploration of the project area consisted of drilling of electromagnetic anomalies for base metal targets. However, the company reports that in spite of limited data, favourable environments for gold mineralization have been defined over a distance of at least 45 km. Results and survey specifications are on file with the Timmins Resident Geologist (McKinnon Prospecting, personal communication, 1991; Timmins Resident Geologist Assessment Files).

Kirkton Resources Limited

A major base metals exploration program was completed in 1991 by Kirkton Resources on the Shunsby Deposit. The property is in the central part of Cunningham Township and can be reached by taking the Sultan, Blamey and Cunningham roads a distance of approximately 85 km from Highway 144.

Work completed consisted of extensive stripping, blasting and sampling of mineralized zones followed by geological mapping. Sulphide mineralization consisting of pyrite, pyrrhotite, sphalerite, chalcopyrite and galena was noted in brecciated iron formation, graphitic chert and intermediate to felsic tuff.

The stratigraphic sequence exposed by stripping consists of hanging wall massive, sheared and pyritized mafic to intermediate volcanic rocks grading into mafic to felsic tuffs, overlain by extensive chert breccia and argillite. Evidence of exhalative sulphide deposition is seen in these "upper" chert breccias in the form of massive pyrrhotite.

Formerly, mineralization at the Shunsby was thought to be stratabound within folded argillaceous chert iron formation. However, due to recent work, it is now thought, that the mineralization has a distinct structural control and is hosted by late, steeply dipping southeast fracture zones. Attempts to trench untested EM conductors to the east of the South and Main zones were unsuccessful and these conductors remain as high priority drill targets.

The following assay results were reported by the company:

Showing	Inferred Width	% Cu	% Pb	% Zn	Ag oz/ton
4+25N	26.2 ft	0.67	1.15	4.30	0.12
Cu Knob	9.8 ft	2.59	0.02	0.32	0.41
4+00N	24.3 ft	2.87	0.78	2.97	0.38
2+75N	3.3 ft	0.69	1.30	5.97	0.20
Cu Breccia	16.4 ft	3.53	0.02	0.52	0.54
1+00S	15.7 ft	0.75	2.76	10.77	0.35

A brief history of property exploration is listed below.

Date	Company	Exploration
1904–07	Ridout Mining Co.	Staked and developed I.F.
1927–29	Ridout Cunningham Mines Ltd.	Diamond drilling for Pb, Zn
1952–53	Page-Harley Mines Ltd.	Trenching, drilling for Cu, Pb, Zn
1954	Cominco	EM Surveys, follow up drilling for Cu, Pb, Zn
1955–65	Consolidated Shunsby Mines Nipiron Mines joint venture	High grade Cu showing discovered 28 000 feet of diamond drilling, geological mapping, ground geophysical surveys
1965–66	FRJ Prospecting Syndicate	14 000 feet of diamond drilling, geological mapping, ground geophysical surveys for Cu, Pb, Zn
1968–69	Consolidated Shunsby	9000 feet diamond drilling, geological mapping for Cu, Pb, Zn
1969–70	UMEX	Geological mapping for Cu, Pb, Zn
1974–75	Grandora Exploration	7500 feet diamond drilling, geochemical Surveys for Cu, Pb, Zn
1978	M.W. Resources	Geological mapping of "Tower" claims, 1200 feet diamond drilling for Cu, Pb, Zn, Ag, Au
1979–80	Placer Development	Ground geophysics, geochemical surveys, 1200 feet diamond drilling for Cu, Pb, Zn, Ag, Au
1981	M.W. Resources	Geological mapping, 3500 feet diamond drilling for Cu, Zn, Au, Ag
1990–91	Kirkton Resources	Stripping, trenching, follow-up drilling planned for 1992

(D.G. Farrow, L.E. Luhta, personal observations, 1991).

North Claybelt Community Futures Committee Clay Project

Using funding supplied under OMIP, the Kapuskasing North Claybelt Community Futures Committee conducted a preliminary study to determine the possible commercial uses of local clays. In consultation with the Timmins Resident Geologist's office, and following reconnaissance prospecting, various sample sites were selected on the basis of access and ease of extraction.

A one-ton sample was excavated from each of 2 test sites in McCrea Township and a series of hand auger samples were taken from alternate sites in Guilfoyle Township. Collected samples of the clay were processed through to the bagged, premixed state in which it would be ready for commercial sale and were sent to Mineral Research Canada for analysis. High lead and barium contents from sampled sites render the clay unsuitable for dinnerware pottery. Commercial clay production was judged to have limited applications as the material from these sites can be utilized for only showpiece or artwork pottery and glazes (North Claybelt Community Futures Committee Clay Project, unpublished report, October, 1991).

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

During 1991, the Timmins Resident Geologist's office was staffed by L.E. Luhta, Resident Geologist; P.J. Sangster, Staff Geologist; D.M. Draper, Data Geologist; C.D. Hamblin, Drill Core Library Geologist; M.L. Leroux, Drill Core Library Geologist Assistant; and D.C. Egerland, Secretary. D.G. Farrow served as Staff Geologist for the Swayze Belt for eight months on a contract basis as replacement for J.C. Ireland who continued to act as Resident Geologist, Cobalt. M.L. Leroux completed a short term assignment to the Kirkland Lake Drill Core Library.

Using funding provided by the Canada Manpower Special Employment Program, temporary staffing was used to update the "reference" field of the Timmins Mineral Deposit Index. The same program allowed the Resident Geologist's office to have all texts, periodicals, technical papers and government publications in the Resident's library entered into a computer indexing system. Some 1600 slides and photos were also inventoried and are ready to be entered into a computer index.

D.M. Draper compiled Geological Data Inventory Folios (GDIF) for five townships in the north Swayze area. Although these folios for Foleyet, Ivanhoe, Kenogaming, Muskego and Sewell townships are unpublished, they are available at the Resident Geologists office. A data compilation was also produced for the area covered by the 1990 Partridge River Area airborne geophysical survey release (OGS 1990).

In spite of a severe decline in exploration and development activity in the district during the year, client use of the Resident Geologist's facilities remained high. From December, 1990 to the end of December, 1991, 2986 office consultations were recorded. This figure does not include participants in any of the 12 field trips provided by the staff or the 664 visits recorded at the Timmins Drill Core Library. In total, 198 files and 38 OPAP/OMIP submissions were incorporated into office assessment file library.

Staff of the Resident Geologist's office made 44 property visits and 15 visits to operating mines. Poster sessions were presented at: the Northeastern Ontario Mines and Minerals Symposium, Northwestern Ontario Mines and Minerals Symposium, the Ontario Mines and Minerals Symposium, the Northern College Career Exposition 1991, Mining Awareness Week, the Timmins Year of the Prospector Celebration, the Prospector's Rendezvous, the Ontario Geological Survey Centenary Opening Ceremony and the Kettle Lakes Provincial Park "Rock Star Weekend".

In September, the Resident Geologist presented a major field tour to several geologists from the Finnish Geological Survey. The tour included field trips and mine tours of all of the major mining camps in northeastern Ontario and was made possible through co-operation of all the Resident Geologists in Northeastern Ontario, the staff of the Hemlo Resident Geologist's Office and many industry representatives. The visiting geologists reciprocated by providing several interesting talks on the geology and ore deposits of Finland.

Although the 11th annual Northeastern Ontario Mines and Minerals Symposium was held in Kirkland Lake, staff of the Timmins Resident Geologist's office played a significant role in its organization and presentation.

A Summary of Mining and Advanced Development in Northeastern Region was compiled and distributed by the Timmins Resident Geologist's office in co-operation with all Resident Geologists in the Northeast Region, Mines and Minerals Division, Ministry of Northern Development and Mines.

A basic prospecting course was presented in Kapuskasing in 1991 with 30 aspiring prospectors in attendance.

All geologists spent considerable time in assisting OPAP and OMIP with submissions and in follow-up property inspections of projects funded by theses programs. A marked improvement in the quality of proposals and final report submissions has been noted.

Geoscience Exploration Data Base (GED) Project

The Mineral Deposit Index (MDI) phase of the GED project was completed for the Timmins Resident Geologist's District as of March 31, 1991. In co-operation with the Geoscience Data Centre over 1400 mineral occurrences were documented and entered into the MDI database by M.V.W. White and Associates Ltd. under direct supervision of the Timmins Resident Geologist's office. Each occurrence was plotted on a 1:50 000 topographic base map. The digitizing of the MDI location map database is expected to be completed by March 1992. These MDI data files are currently available for viewing upon request. Computer system upgrades to provide in-office access to GED data were installed in the fall of 1991. Under a special employment program through Canada Manpower, these records were subsequently upgraded to include additional geological references and assessment file information.

L. Luhta and C. Hamblin continued as members of the Provincial Drill Core Library Committee. M. Leroux, as an executive member of the Porcupine Geological Discussion Group, was responsible for organizing many interesting and informative technical talks for the local geological community. P. Sangster represented the region on the Ministry of Northern Development and Mines Education and Publicity Committee and acted as local co-ordinator for the Timmins GED project.

Property Examinations

TINTINA MINES LTD., ENGLISH TOWHSHIP

During 1990, GSW Bruce Prospecting Grubstake discovered a gold occurrence in the Ferrier Creek Road in the eastern part of English Township (claim P.1132675), approximately 1.7 km due south of Muskrat Lake. Following the staking of claims, sampling of the principal occurrence, the 'Road Showing', returned assays ranging from 0.36 g/t to 3.5 g/t Au. Other alteration zones were sampled during geological mapping of the area in 1990. In early 1991, the property was optioned to Tintina Mines Ltd. Additional staking expanded the property to 77 contiguous claims. Another gold occurrence, discovered by Esso in 1987 (the '43N Showing') and located approximately 2 km to the south, is now included in this land package.

Conventional prospecting and a magnetic survey have been completed over the claims. Stripping, detailed mapping and sampling of the 'Road Showing' were completed in the spring and early summer of 1991. This was followed by 5 diamond-drill holes in the fall of 1991, 3 of which were drilled under the 'Road Showing' and 2 beneath the '43N Showing' to the south.

The property is located in east-central English Township, 55 km south of Timmins. The claim group is bounded by the Redstone River to the east and Ferrier Creek to the west. Access is by an all weather gravel road from South Porcupine.

English Township was mapped along with Zavitz Township by Bright in 1967 and 1968 (Bright 1984). It was also included in an area of regional mapping by Pyke in 1972 (Pyke 1982). The property is situated on the contact between the older Archean Deloro Group (calc-alkalic volcanic rocks, minor mafic volcanic rocks and oxide and sulphide iron formation) and the Lower Formation of the Tisdale Group (mainly ultramafic and basaltic komatiites and tholeiitic basalts). The area has been folded into tight isoclinal folds with east-trending fold axes, intruded by granitoids and faulted by mainly north-trending faults.

The Resident Geologist visited the 'Road Showing' in July, 1991. Extensive stripping and trenching has been completed over an area of 150 m by 150 m. The main showing consists of a red felsic rock, approximately 11 m wide, exposed for a strike length of 25 m. This unit is exposed in another trench to the northwest and appears to be offset by 10 m, possibly due to a northwest-striking fault. The felsic rock contains a minor amount of chloritic clots up to 1 cm in diameter which may represent small xenoliths. Fine quartz stringers up to 1 cm in width are common throughout, with one set oriented perpendicular to the strike of the felsic body and another set having an irregular orientation. Pods of up to 20% pyrite occur throughout the rock.

The felsic rock is in contact with aphanitic, dark green, mafic volcanic rock with carbonate (calcite) alteration. The mafic rock is foliated parallel to the contact. The contact observed is both diffuse and sharp which may suggest that the felsic rock may be a silicified, feldspathized and hematized alteration zone rather than an intrusive. The mafic volcanic rock away from the contact contains pillows with a top direction of 104°.

Surface sampling by Tintina Mines Ltd. of this felsic unit returned assay values from 40 of 50 samples of greater than 500 ppb Au. The highest assay was 2.5 g/t Au over 1.5 m. Most of the higher gold values appear to be directly related to the amount of pyrite contained in the rock and/or the quartz stringers.

Approximately 10 m to the northwest of the felsic unit is a 5 m wide zone of sheared, completely carbonatized mafic volcanic rock containing quartz-feldspar porphyry dikes up to 2 m wide. The shear zone and intruded dikes strike 020° and dip vertically. This zone contains anomalous gold values with one grab sample reported to have assayed 3.5 g/t Au.

In the southeast part of the stripped area, a 2 to 3 m wide band of quartz-sericite schist containing up to 5% disseminated pyrite was observed within the mafic volcanic rocks. The foliation of this unit strikes 032°. In the northeast corner of the trenched area, a quartz-feldspar porphyry in contact with what appeared to be a carbonated komatiitic rock was observed. Also in the northeast corner, a felsic unit similar to the main showing is in contact with a calcitic mafic volcanic rock with up to 5% disseminated pyrite.

Three diamond-drill holes were drilled underneath the 'Road Showing' in the late fall. Anomalous gold values of up to 3 g/t Au were reported. One hole was drilled directly beneath the felsic unit to intersect it at depth. No felsic rocks were reported but rather a fuchsitic fragmental rock was intersected. The absence of the felsic unit in the drill core may be due to offseting by a horizontal fault, or the felsic unit plunges in a manner such that the drill hole was drilled beneath it.

Two other diamond-drill holes were completed on the former Esso Minerals '43N Showing'. Stripping by Esso uncovered an iron-rich tholeiitic basalt containing quartz veining and pyrite near the margin of a 200 to 400 m wide band of carbonate-altered komatiite. Anomalous gold values from 200 to 700 ppb Au were intersected over a width of 10 and 15 m.

Bright (1984) has described most of the gold showings in English Township. They are commonly associated with quartz-carbonate veining in pyritized basalts and less commonly in quartz veins occupying sheared portions of porphyry bodies. Numerous gold prospects occur in English and Semple townships to the south of the Tintina property. They have been worked by several companies and most of the gold showings occur in iron formations or sulphide zones in sheared mafic to felsic volcanic rocks.

The Tintina property is shown to occur on the contact between the Deloro Group and the Lower Formation of the Tisdale Group (Pyke 1978). Recently published magnetic maps appear to confirm that this interpretation is correct. Most of the gold producers in the Porcupine Camp are located near this geological contact (L.E. Luhta, Timmins Resident Geologist's office, personal observations, 1991).

J. BOISSONEAULT PROPERTY, MASSEY TOWNSHIP

In the summer of 1991, J. Boissoneault, a local prospector, staked 2 claims (six 16 hectare units) over 3 AEM anomalies in northwestern Massey Township. Before staking, reconnaissance prospecting was completed along the Kamiskotia Gabbroic complex in western Massey Township. Although Noranda Exploration had originally staked claims here following the release of the Timmins Airborne Survey in 1988, there is no evidence that any work was done on the property and the claims were allowed to lapse. There is no assessment work on file for the property and no indication of any previous work. There are no other active claims or exploration programs in the area.

An amendment was made to Mr. Boissoneault's OPAP grant to allow him to work in this area which he considers to have high mineral potential instead of his originally proposed project in Michie Township. Six line-miles of grid lines have been cut. Georgex Exploration Services of Timmins was contracted to complete a Max-Min II survey on the grid and Mr. Boissoneault surveyed the property using a fluxgate magnetometer (MF-1).

At the time of the property visit, the Max-Min II survey was in progress. Initial results did not confirm the location of the airborne EM anomalies. Additional survey lines at different orientations were planned to locate the anomalies.

The property is located in the northwest quarter of Massey Township, 1.2 km southeast of Massey Lake. To access the property, Highway 101 west is taken from Timmins to a turnoff approximately 1 km west of the Mallette lumber mill. The Mallette Logging Road is followed north for approximately 35 km.

Ontario Geological Survey Map 2205, Geology of the Timmins–Kirkland Lake Area, at a scale of 1 inch to 4 miles is the only published map of the area and shows it to be underlain by " metamorphosed mafic and ultramafic rocks". Since the area has never been mapped in detail, it is assumed that the geology as published was interpreted from airborne geophysical surveys. Barrie (1989) shows the property to be underlain by the Kamiskotia Gabbroic Complex and related gabbroic rocks; a contact intrusive breccia zone and a narrow wedge of lower mafic volcanic rocks. In general, strikes and dips show the schistosity as striking to the northwest and dipping steeply to the northeast. Kirwan (1991) has interpreted the property geology as being part of an east-trending belt of metagabbro and granitic gneiss with possible contact breccia or shatter breccia present due to regional faulting. The rocks are tightly folded with dips approaching vertical.

In the very early stages of it's exploration, P.J. Sangster visited the property. Geological mapping had not yet been initiated and geophysical surveys were in progress. Accompanied by the property holder and R. Huggins, OPAP evaluator, three outcrop exposures on the property were examined. The property is transected by a large diabase dike (50 m wide) striking 345° to 350° and having a nearly vertical dip. The dike is relatively unaltered, although the property holder has reported some saussuritized "goose eggs" and typical chill margin textures. Other outcrops observed included a small exposure of metagabbro believed to be part of the lower zone of the Kamiskotia Gabbroic Complex. In contact with the metagabbro, the lower contact breccia was also examined and observed to consist of a metagabbro matrix with gneissic, dioritic, and metavolcanic clasts. Near the contact, the breccia appears to be highly altered. No exposures of metavolcanic rocks were examined.

During the course of the summer and fall, Mr. Boissonealt continued to bring rock samples to the Resident Geologist's office for mineral identification and for discussion. Subsequent to the completion of the geophysical surveys on the property, a small gossan zone was uncovered at the contact between the metagabbro and the contact breccia dipping 080° east. The zone is reported to consist mainly of iron oxides. Samples have been collected and sent for analysis. In addition, disseminated sulphides including pyrite, chalcopyrite and bornite have been noted in small fractures in the matrix of the contact breccia. Work done on the property to date has not explained the airborne 11 and 12 channel electromagnetic conductors and coincident magnetic anomalies as shown on Map 81075 (OGS 1988).

Outcrop on the property is relatively plentiful but discontinuous. Additional stripping, geological mapping and geophysical surveys are planned for 1992 (P. Sangster, personal observations, 1991).

M. JEAN PROPERTY, DOHERTY AND PELLETIER TOWNSHIPS

In August, 1991, M. Leroux visited the Mauril Jean property in northwest Doherty Township to observe the progress of an ongoing diamond drill program. Mr. Jean, a prospector from Hearst, financed his 1991 program with funding provided under OMIP.

The property consists of 30 unpatented mining claims situated in the unsubdivided townships of Pelletier and Doherty, 72 km to the south of the town of Hearst. The claim group is accessed by using an all-season timber management road maintained by the Hearst Lumber Company, locally known as the Caithness Road.

The diamond drill was set up on a large stripped outcrop approximately 800 m long and 10 m wide, located in the northwest quarter of Doherty Township. The outcrop appeared to be silicified mafic volcanic rock trending 045° and having a nearly vertical dip. A moderate shear zone paralleling the stratigraphy hosts up to 30% sulphide mineralization at surface and is the target of the diamond-drill program. The zone varies from 1 to 3 m in width. Although pyrite was the predominant sulphide mineral noted, some chalcopyrite was also observed on fresh surfaces of the outcrop and also in the drill core. Very little sphalerite was noted on surface, however, zinc bloom was common across the outcrop. Epidote alteration was present as fracture filling in or near the shear and as large patches and blebs within 1 m of either side of the shear.

Previous surface sampling of the outcrop yielded assays of 13 000 ppm and 10 000 ppm Zn. Grab samples collected from the shear zone were highly silicified, with abundant zinc bloom and small amounts of epidote. The owner has taken over 400 surface rock samples from the area since April 1991. Assays of these samples returned background to moderately anomalous values in Zn, and background values in Cu, Pb, Ag, and Au. The owner also reported that over 300 percussion holes had been drilled and sampled across the shear zone. No assay results from this program were made available.

At the time of the visit, the diamond-drill hole had reached a depth of 496 feet, with plans to extend it a further 100 feet as the owner thought that he had yet to intersect the shear zone. Examining the core revealed a 1.5 m zone of shearing in an altered mafic volcanic with 10 to 20% disseminated sulphides. Small seams and patches of sphalerite were also noted.

The property owner has plans to drill an additional hole to the north, along strike of the original showing. Further diamond drilling may be completed to test a tuff/mafic volcanic contact to the south of the property (M. Leroux, personal observations, 1991).

SODIC FENITIZED ZONE, BRISTOL TOWNSHIP

In August, 1991, the author accompanied Dr. K. Barron, a post doctorate researcher from the University of Western Ontario, on a site inspection of several properties in southwestern Bristol Township. Dr. Barron is particularly interested in a recently indentified, linear carbonatite striking through Bristol, Price and Fripp townships. Original plans were to examine an area stripped by J. Croxall in Bristol Township. Mr. Croxall had written to Dr. Barron concerning anomalous rare earth element values returned from samples in the this area. Mr. Croxall had also discussed the property with L. Luhta, Resident Geologist, Timmins, who in turn had consulted R. Sage, the Ontario Geological Survey resident expert on carbonatites in Ontario. Details of these discussions and sampling results may be found in the Resident Geologist's file (Croxall, J., Bristol Township).

However, enroute to the Croxall property, the author and Dr. Barron noticed orderly stacks of drill core, from drilling performed by Chevron Resources in 1988. Core was removed for examination and returned to its original location carefully. As the core was being examined, the author recorded the appropriate drill hole numbers and footages.

The following minerals were visually identified in the core by Dr. Barron: reibeckite, aegerine, richterite, eudialyte, cancrinite. Subsequent comparison with the drill logs revealed that these minerals had not been previously identified. The presence of these minerals supports the argument that this feature is a sodic fenite zone (Barron 1991). Although a strong spatial relationship between Archean lode gold deposits and alkaline rocks of the Superior Province has long been recognized, the presence of igneous carbonatites and related fenite zones in proximity to these gold deposits has only recently been discovered.

The economic significance of the rare earth elements found in southwestern Bristol Township is as yet unknown (assessment files, Timmins Resident Geologist's office; P. Sangster, personal observations, 1991).

J. LILL PROPERTY, PEARCE TOWNSHIP

During 1991, using funding provided by OPAP, J. Lill diamond drilled 1 hole to a depth of 463 feet on his six claim property in Pearce Township. The drill core was logged and sampled by Mr. Lill and subsequently re-examined by the core library geologist in the Timmins Drill Core Library, where the core is now stored. Pearce Township is 25 km north-northwest of Kapuskasing, Ontario. The property is located in the east-central part of the township and is bracketed on either side by major northeast-trending faults striking between the Clay-Howells carbonatite complex to the northeast and the Cargill carbonatite complex to the southwest.

The property is located in an area comprised of Archean metasedimentary rocks including greywacke, arkose, quartzite, amphibolite and phyllite. Outcrop is sparse in the area, thus the geological interpretation is largely based on regional airborne geophysical surveys. Examination of the diamond-drill core indicates that the area is also underlain by migmatite (metasedimentary and metavolcanic rocks) as well as migmatitic granites and granitic gneisses.

During the 1960s, Inco Ltd. drilled 7 holes in the area and recorded sulphide mineralization in sedimentary rocks. The Inco drilling was located between 1.25 to 4.5 miles to the south and 1.25 miles to the north of J. Lill's property. Kapuskasing Resources held 12 claims in the early 1980s on the adjacent ground, to the south of the Lill property, on which geological mapping of the sparse outcrop and magnetic, VLF, IP and radiometric surveys were conducted. Although several IP anomalies were identified, no further work was done and the claims were forfeited. There has been no other exploration in the area.

Six claims were staked by J. Lill in October, 1989. IP and ground magnetometer surveys were conducted during 1990, with funding provided by OPAP. The diamond-drill hole completed during the 1991 exploration program was drilled to test an IP anomaly in an area of low magnetic response. Boulders containing disseminated chalcopyrite had been found previously, 2 miles south of the drill hole collar.

Although no gold values and very low base metal values were obtained from the limited sampling of the drill core, there were slightly anomalous values of various other elements reported. These include: up to 0.1% Ba, 364 ppm Sr, 80 ppm Rb, 72 ppm Ce, 71 ppm Y, 30 ppm Nd and 30 ppm La. These results were not expected and were only found through a spectrographic analysis of the samples.

The drill core is comprised of moderately foliated, high-grade metamorphic gneisses, probably amphibolite facies, and is not heavily mineralized with sulphides. In intersections from 252 to 359 feet and again from 366 to 401 feet, the core is comprised of a garnetiferous hornblende-biotite-quartz-feldspar gneiss. These units are medium- to coarse-grained, light to pinkish in colour and contain minor amounts of pyrite in places. The drill core intersection from 359 to 366 feet is a biotite-quartz-feldspar gneiss that is finer grained than the previous unit and darker in colour, with a higher percentage of biotite but virtually no hornblende. The drill core from footage 401 to the end of the hole is a quartz-biotite gneiss that is very similar in appearance to the previously described unit but is appears to lack feldspar and has varying amounts of garnet present. Pyrite is occasionally present as well as an earthy yellowish material (possibly leucoxene) which appears to be coincident with some of the better rare earth element values. Very little of the core was sampled and sampling was based on the sparse occurrence of sulphide mineralization. Further sampling of the core for rare earth elements may be warranted. (J. Lill, personal communication, 1991; Assessment Files, Timmins Resident Geologist's office; Stored drill core, Timmins Drill Core Library; C.D. Hamblin, personal communication, 1991).

ROSS–MORIN PROPERTY, MALLARD TOWNSHIP

The property consists of 85 contiguous claims in south-central Mallard Township.

Access to the site from Timmins is afforded by travelling south on Highway 144 to the Watershed Restaurant and the Sultan turn-off. After travelling west for 32.4 km on the Sultan Road, a major access road which branches to the northwest is followed for a further 12.6 km to the 'Mallard Road'. The property is approximately 28 km north-northeast of and about 1.5 km east of the Opeepeesway River.

Site no. 1, the original gold showing, is on the south side of the road 1.1 km east of the Opeepeesway River. The outcrop is exposed in an area of approximately 25 m by 5 m which was expanded during a recent stripping program. It consists of a moderate to strongly foliated fine-grained, grey, mafic (possibly tuffaceous) volcanic rock. The foliation strikes 318° and dips steeply to the west. Weathered surfaces are green-beige and exhibit hematite staining with fine-grained cubic pyrite occurring throughout in trace amounts to 20% locally. Carbonate alteration varies from weak to moderately strong, as does silification.

Quartz veining is predominantly parallel to foliation, striking at about 320° and dipping, on the average, between 70° to 75° to the west. Quartz-carbonate healed fractures are common, most frequently striking at 300° and again dipping steeply to the west.

At the north end of the exposure, a medium-grained, beige-pink, porphyry dike from 1 to 1.5 m in width, cuts the mafic volcanic rocks subparallel to foliation. It exhibits patchy carbonate alteration and sulphide mineralization of up to 1% fine-grained euhedral pyrite. Conjugate joints sets at 020°/080° and 350°/050° were noted.

At the south end of the outcrop, the rocks are z-folded with barren quartz-filled tensional cracks and truncated by a dark green-black, magnetic, gabbroic intrusive rock. The contact of the intrusive rock with the sheared volcanic rocks strikes at 284° and extends at least 25 m southward into the bush.

Site no. 2 is about 25 m south of the road, 1.4 km east of the Opeepeesway River and appears to have been stripped within the past few years. No signs of previous sampling were observed. At the time of the visit the outcrop had an exposure of approximately 30 m by 50 m. The exposure has since been expanded and sampled with a channel saw.

The lithology is predominantly dark green-grey sheared mafic volcanic rock, chloritized and sericitized, containing 1% to 3% disseminated euhedral pyrite and veined with quartz and quartz-carbonate. The rocks are variably foliated along an azimuth of 320° and dip steeply southwest with local tight-folding and crenulations.

Episodic fracturing and silica flooding is present, the largest system consisting of boudinaged quartz and quartz-carbonate veins emplaced parallel to foliation and coincident with those rocks exhibiting the highest degree of deformation. These veins dip steeply to the southwest, are often ankeritized along one or both margins and have a maximum vein width of approximately 10 cm.

A felsic porphyry contact running roughly parallel to foliation was noted at the northeast end of the exposure. Quartz and quartz-carbonate veins about 1 cm maximum in width at 050° and 350° are common in the porphyry, as is jointing at 015° dipping 80° east.

Mineralization observed at some of the sample sites includes pyrite, chalcopyrite, hydrous muscovite, tourmaline, and in at least one location, visible gold. Most of the sulphide mineralization occurs in the country rock, while the gold and minor sulphides are found in quartz veins.

Nine grab samples were collected from both sites. The best assay results were 0.404 ounce Au per ton and 0.026 ounce Au per ton (D. Farrow, L. Luhta, M. Leroux, Timmins Resident Geologist's office, personal communication, 1991).

G. MUSSELY PROPERTY, PARNELL TOWNSHIP

In July, 1991, M. Leroux visited the G. Mussely property in northeast Parnell Township, accompanied by Mr. G. Mussely. The property consists of 4 contiguous, unpatented mining claims and is accessed by taking Highway 11 west from Kapuskasing to a bush road approximately 2 miles east of Opasatika and progressing a further 9 miles southwest on this road.

Hollinger Mines explored the area in 1956, but ground geophysical surveys, surface sampling and a few limited diamond-drill holes failed to return any significant results and no further work was done.

Several locations on the property were examined including pits excavated both by the present claim holder and by Hollinger Mines in 1956. Stop 1 was a pit excavated by Mr. Mussely in which a band of cherty iron formation less than 1 m wide is well exposed. This iron formation is mineralized with up to 80% pyrite, trends 085° and has a near vertical dip. As well as zones of massive pyrite, narrow bands of cubic and disseminated pyrite separated by a succession of grey chert bands were noted. The host rock appears to be a garnetiferous, quartz-biotite gneiss.

The second stop, Pit no. 2, was similar to the first pit, but here the iron formation is mineralized only to approximately 50% with cubic and disseminated pyrite. A series of 2 to 5 inch, sugary textured, barren quartz veins crosscut the stratigraphy. The relationship between these veins and the east-trending iron formation has not been determined. The trend of the iron formation observed at the first stop suggests that this pit exposure may be a westward extension of the same formation. This would indicate a possible strike length of 1300 feet. Exposure is limited to the pit areas.

Pit no. 3, approximately 150 feet southeast of Pit no. 2, uncovered an intensely silicified sedimentary rock displaying little or no primary features. Mineralization is less than 5% disseminated pyrite and magnetite.

The fourth stop was at a granitic outcrop in the northwest corner of the claim group. A small trench had been blasted into a quartz vein on the west face of the outcrop but on visual examination, no mineralization was evident.

The property owner plans to strip and trench the iron formation, pending encouraging assay results from sampling (M. Leroux, Timmins Drill Core Library, personal communication, 1991).

Drill Core Library Program

The Timmins Drill Core Library serves the mining and exploration community of the Timmins Resident Geologist's District. During the past year representatives of industry, universities and government made 664 visits to the Timmins Drill Core Library facilities. A total of 30600 m of drill core was collected in 1991 (Table 13.4). The Core Library inventory currently stands at 148190 m of drill core, representing 575835 m of drilling from 3918 holes. An off-site storage location was established this past year to accommodate excess core inventory and 16950 m of core is presently stored off-site. This additional storage area will eliminate the need to telescope drill holes in future. Clients wishing access to off-site core are requested to notify Core Library staff in advance.

RECOMMENDATIONS FOR EXPLORATION

East-Central Bristol Township

A published government geology map of this area (Pyke et al. 1973) shows that the western extension of the Porcupine Destor Fault Zone possibly extends through metasedimentary rocks in the east-central part of Bristol Township. Most explorationists working in the area through the gold boom of the 1980's suggested that the fault zone is offset more to the south by the Mattagami River and may actually pass through Thorneloe and Denton townships within a thin band of volcanic rocks (Pyke et al. 1973). The possibility of a splay fault or faults off the Porcupine Destor Fault Zone may exist in the east-central part of Bristol Township.

Dome Exploration (Canada) Ltd., the predecessor to Placer Dome Exploration, began exploring for gold in the

Table 13.4. Additions to Timmins Drill Core Library Collection since November 1, 1990.

Township	Number of Holes	Total Depth (m)	Core Stored Inside (m)	Core Stored Outside (m)
Alexandra	1	72.2	1.6	0.0
Aubin	7	309.0	2.3	0.0
Blackstock	1	83.2	2.0	0.0
Bristol	19	5312.1	710.9	1666.6
Crawford	5	176.6	2.2	0.0
Dargavel	9	362.4	4.1	0.0
Denton	4	826.5	381.0	389.1
English	1	126.8	123.4	0.0
Fripp	14	1786.4	187.0	0.0
Hoyle	7	2041.4	1315.3	364.0
Kingsmill	3	66.9	1.1	0.0
Lennox	1	15.5	0.4	0.0
Lucas	2	943.0	611.7	298.7
Mabee	8	234.7	2.4	0.0
Mahaffy	3	408.0	291.3	0.0
Mann	5	262.2	0.0	261.3
Matheson	14	3023.1	1265.4	850.7
McArthur	3	581.2	0.0	522.7
Muskego	3	400.6	385.1	0.0
Nesbitt	8	315.4	3.9	0.0
Pearce	1	141.1	64.3	0.0
Penhorwood	41	10 467.6	0.0	0.0
Price	2	509.4	281.6	172.0
Reid	3	646.9	518.8	0.0
Thorneloe	9	2187.8	1278.7	661.0
Wark	1	179.8	10.1	0.0
Whitney	2	311.5	279.5	0.0

Persons requiring further information or wishing to examine or donate drill core should contact:
Ontario Ministry of Northern Development & Mines, Drill Core Library, 896 Riverside Drive, Timmins, Ontario P4N 3W2 Tel: 705-360-8370

east-central part of Bristol Township in 1984. Exploration continued until 1988 with approximately 80 diamond-drill holes being drilled. Zones of quartz-feldspar porphyry with alteration features such as sericitization, carbonatization, silicification, red hematization and possibly albitization were intersected over an extensive area at least 2000 by 1000 m. Erratic gold values of up to 10 000 ppb were also recorded in several drill core intersections.

In 1986, Utah Mines Ltd. diamond drilled 1 hole 2000 m west of the most western drilling by Placer Dome. The hole intersected over 180 m of quartz-feldspar porphyry and was terminated within the porphyry. Alteration features such as sericitization, red hematization, silicification were noted along with a trace of molybdenite.

In 1985, L.E. Luhta had the opportunity to examine core from a few holes drilled by Dome Exploration from their Bristol Township property. Many similarities exist between this core and rocks which host the McIntyre copper-gold-molybdenum deposit. While doing his Masters thesis on this deposit, L.E. Luhta (1974) mapped 3 distinct alteration zoned assemblages within the ore-hosting Pearl Lake Porphyry: 1) a strongly fissile, cream-coloured quartz-sericite-albite-carbonate schist containing small, glassy quartz eyes; 2) a medium- to coarse-grained granitoid—red albite-quartz (with minor anhydrite-hematite) assemblage; and 3) a medium- to coarse-grained granitoid—grey albite-quartz assemblage containing a sericite-quartz core. Ore lenses of copper, gold and molybdenum mineralization occur within the inner zones (2) and (3), with (3) being the innermost zone. Geochemical studies indicate that alteration consisted of initially sodium metasomation (albite), followed abruptly by potassium and hydrogen alteration (sericite). This was associated with changes in the fugacity of oxygen (deposition of hematite and anhydrite) and sulphur (deposition of sulphides).

Similar alteration patterns to the McIntyre copper-gold-molybdenum deposit have been observed by L.E. Luhta at other mines such as the Ross Mine in Hislop Township, the Goldpost (New Kelore) Mine in Hislop Township and the old Jerome Mine in Osway Township.

On a recent tour to Hemlo, rocks strikingly similar to the McIntyre deposit were observed underground at the Williams Mine. From south to north through the footwall of the ore deposit, L.E. Luhta observed mafic volcanic rocks, metasedimentary rocks, a "red" (possibly hematized) quartz porphyry

Table 13.5. Gold production from the Timmins Resident Geologist's District (to the end of 1990)

Mine Name	Township	Years of Production	Tons Milled	Oz. Produced	Grade
Ankerite	Deloro	1926–53, –78	4 993 929	957 292	0.19
Ankerite/March	Deloro	1926–35	317 769	61 039	0.19
Aquarius	Macklem	1984, 1988–89	139 634	27 117	0.23
Aunor (Pamour No.3)	Deloro	1940–1984	8 482 174	2 502 214	0.30
Banner	Whitney	1927–28, –33, –35	315	670	0.13
Bell Creek	Hoyle	1987–	485 013	85 561	
Bonetal	Whitney	1941–1951	352 254	51 510	0.15
Bonwhit	Whitney	1951–1954	200 555	67 940	0.34
Broulan	Whitney	1939–1953	1 146 059	243 757	0.21
Cincinnati	Deloro	1922–1944	3 200	736	0.23
Concordia	Deloro	1935	230	16	0.07
Coniaurum/Carium	Tisdale	1913–18, 1928–61	4 464 006	1 109 574	0.25
Crown	Tisdale	1913–1921	226 180	138 330	0.61
Davidson	Tisdale	1918–1920	9 341	2 438	0.26
		1988	43 850	7 301	
Delnite	Deloro	1937–64	3 847 364	920 404	0.20
(open pit)	Deloro	1987–88	59 067	3 602	0.77
DeSantis	Ogden	1933, 39–42	196 928	35 842	0.18
		1961–64			
DeSantis	Turnbull	1926		13	
Detour Lake Mine	Sunday Lake	1983–	5 870 000	651 344	
Dome Mine	Tisdale	1910–	48 201 916	11 695 914	
Faymar	Deloro	1940–42	119 181	21 851	0.18
Fuller	Tisdale	1940–44	44 028	6 566	0.15
Gillies Lake	Tisdale	1929–31, 35–37	54 502	15 278	0.28
Goldhawk	Cody	1947	636	53	0.08
Goldhawk (open pit)	Cody	1980	40 000	3 967	0.10
Halcrow–Swayze	Halcrow	1935	211	40	0.19
Hallnor (Pamour No.2)	Whitney	1938–68, –81	4 226 419	1 645 892	0.39
Hollinger–Schumacher	Tisdale	1915–18	112 124	27 182	0.24
Hollinger	Tisdale	1910–68	65 778 234	19 327 691	0.29
(Pamour Timmins)		1976–88	2 615 866	182 058	0.07
Hoyle	Whitney	1941–44, 46–49	725 494	71 843	0.10
Hoyle Pond	Hoyle	1985–	616 608	325 963	0.61
Hugh–Pam	Whitney	1926, 48–65	636 751	119 604	0.19
Jerome	Osway	1941–43, 56	335 060	56 893	0.17
Joburke	Keith	1973–75, 79–81	440 117	43 571	0.10
Kingbridge/Gomak	Chester	1935–36	1 387	98	0.07
McIntyre (Pamour Schumacker)	Tisdale	1912–88	37 634 691	10 751 941	0.29
McLaren	Deloro	1933–37	876	201	0.23
Moneta	Tisdale	1938–43	314 829	149 250	0.47
Naybob	Ogden	1932–64	304 100	50 731	0.17
Owl Creek	Hoyle	1981–89	1 789 247	223 671	
Pamour No.1 (incl. pits 3, 4 and heap leach)	Whitney	1936–	36 107 481	3 484 711	
Paymaster	Tisdale	1915–66	5 607 402	1 192 206	0.21
Porcupine Lake/Hunter	Whtney	1937–40, 44	10 821	1 369	0.13
Porcupine Peninsular	Cody	1924–27, –40, –47	99 688	27 354	0.27
Preston	Tisdale	1938–68	6 284 405	1 539 355	0.24
Preston N Y	Tisdale	1933	2 800	153	0.05
Preston/Porcupine Pet	Deloro	1914–15		314	
Preston/Porphyry Hill	Deloro	1913–15	46	312	6.78
Reef Mine	Whitney	1915–65	2 144 507	498 932	0.23
St. Andrew Goldfields (to Oct./90)	Stock	1989–	199 869	25 600 est	0.15
Tionaga/Smith–Thorne	Horwood	1938–39	6 653	2 299	0.35
Tisdale Ankerite	Tisdale	1952	14 655	2 236	0.15
Tommy Burns/Arcadia	Shaw	1917	21	14	0.28–0.34
Vipond	Tisdale	1911–41	1 565 218	414 367	0.26

N.B. ERG Resources Inc. produced 18 260 oz. Au from treatment of 2 549 189 tons of tailings from March 1988 to June 1989.

Table 13.6. Base metal production, Timmins Resident Geologist's District (to the end of 1990).

Mine	Township	Date	Ore Milled (Tonnes)	% Cu	% Zn	% Ni	Ag (G/Tonne)	Au
Alexo	Dundonald	1912–19 1943–44	51 529	0.07		3.93		
Canadian Jamieson	Godfrey	1966–71	800 600	2.39	4.05			
Jameland	Jamieson	1969–72	461 805	0.99	0.88		3.50	0.05
Kam Kotia	Robb	1943–44 1961–72	6 007 194	1.09	1.03		3.50	0.05
Kidd Creek Mine	Kidd	1965–	85 100 000	2.06	7.18		106.00	
Langmuir #1	Langmuir	1973–77 1990–	220 000			1.50		
Langmuir #2			320 000			1.30		
McIntyre	Tisdale	1963–81	10 162 640	0.62			0.09	0.023
Redstone	Eldorado	1989–	54 725			2.3		
United Obalski	Godfrey	1965–66	254					

zone, a quartz-eye sericite schist, and the ore zone within a grey feldspathic (microcline) rock containing barite with 8% sulphides—mostly pyrite with some molybdenite.

Metasomatism and alteration consisting of microclinization (potassium enrichment), sericitization (potassium and hydrogen alteration), biotitization, albitization (sodium enrichment), pyritization and tourmalinization at Hemlo have been described in the literature. Barite, a sulphate in the Hemlo deposit, may have been deposited during a period of high oxygen fugacity along with hematite in the red porphyry zone similar to the deposition of anhydrite (also a sulphate) and hematite at the McIntyre deposit.

The Pearl Lake Porphyry at the McIntyre deposit is along the eastern extension of the Hollinger Main Fault, a possible offset splay off the Porcupine Destor Fault Zone.

Similarly, the Hemlo deposits lie along the Lake Superior Shear Zone, a possible splay off the Heron Bay–Hemlo Fault Zone at a flexure point along the fault system.

Although no detailed studies of drill core from the rocks in the east-central part of Bristol Township have been done, cursory examinations suggest that they may be lithologically and possibly geochemically similar to rocks which host the McIntyre copper-gold-molybdenum deposit and the Hemlo gold deposits. Within Bristol Township, porphyry bodies with red hematite alteration, sericitization and possibly albite metasomation have been intersected for a strike length of over 4000 m. Pyrite, chalcopyrite, molybdenite and gold values have also been recorded in drill core intersections from this area. This zone of porphyritic intrusions may occur along a splay or splays off the Porcupine Destor Fault. This favorable geology occurs within 10 km to the west of one of the most prolific gold-producing areas in North America. For all of these reasons, the east-central portion of Bristol Township is therefore suggested as a potential area for hosting gold mineralization of economic significance (L.E. Luhta, Timmins Resident Geologist's office, personal observations, 1991).

Siliceous Ore Required

The Kidd Creek Division of Falconbridge Limited is seeking precious-metal-bearing siliceous ore for flux at its copper smelter in Hoyle Township. The company requires up to 250 000 tonnes of silica annually and wants ore with as high a silica content as possible. Former sources of silica have included: Roseval Silica, Penhorwood Township; Anglo Dominion Ltd., Leeson Township; and high silica ore from the company's own Owl Creek Mine. The siliceous ore from the Anglo Dominion Property averaged 80% silica and 0.20 ounces Au per ton.

Falconbridge Ltd. has investigated a number of local sources for silica including various sands which were found to contain too high a percentage of orthoclase feldspar. Although material with as low as 65% silica may be acceptable, a penalty is charged for ore that is less than 75% silica. To be acceptable, ore must have less than 5% total alkalis and less than 8% alumina. In addition, ore from argillaceous environments cannot be used in the smelter. The presence of certain elements, tellurium for example, will also make siliceous materials unsuitable. Potential sources are evaluated on an individual basis. When the material meets the specifications established by Falconbridge Ltd., deposit owners are required to mine and transport it to the Hoyle Township site. Payment is subsequently made by Falconbridge Ltd. for any precious metals recovered from the ore (Falcobridge Limited, personal communications, 1991).

Table 13.7. Maps and reports pertaining to the Timmins Resident Geologist's District, issued by the Ontario Geological Survey in 1991.

Open File Reports	
OFR 5420	Geology of the Martison Carbonatite Complex
OFR 5749	Summary of Results from the Black River–Matheson (BRiM) Reconnaissance Surface Till Sampling Program
OFR 5738	Dating Ontario's Gold
OFR 5756	The Hollinger–McIntyre Gold-Quartz Vein System, Timmins, Ontario: Geologic Characteristics, Fluid Properties and Light Stable Isotope Geochemistry
OFR 5767	Field Guide to Structural Geology of Tisdale and Whitney Townships
OFR 5785	The Geology of the Northwestern Black River–Matheson Area
OFR 5744	An Ichnological and Sedimentological Study of Devonian Black Shales from the Long Rapids Formation, Moose River Basin, Northern Ontario
OFR 5764	Soapstone in Ontario
OFR 5777	Mesozoic Geology and Lignite Potential of the Moose River Basin
OFR 5741	Cyanide in Gold Deposits
OFR 5745	Lead Isotope Study of Gold Mineralization in the Dome Mine Quartz-Fuchsite Vein
OFR 5747	Computer Software for Micro-PIXE Analysis of Mineralogical Specimens
OFR 5757	Evaluation of Geobotanical Remote Sensing as an Aid to Mineral Exploration in Northeastern Ontario
OFR 5781	High Resolution Seismic Reflection Profiles across the Kapuskasing Structure
OFR 5790	Site Survey for the Canadian Continental Drilling Program's Pilot Project in the Kapuskasing Uplift
OFR 5797	Field Work Specifications for the Ontario Peatlands Inventory Project
OFR 5803	Geological and Geochemical Setting of 3 Gold Occurrences in the Horwood Lake Area, Central Swayze Belt
OFR 5812	Physical and Chemical Processes of Archean Subaqueous Volcaniclastic Rocks
OFR 5811	Aggregate Resources Inventory of the Moosonee Area
OFR 5800	Geochemistry of Tills from the Black River–Matheson (BRiM) Sonic Overburden Drilling Program and Implications for Exploration
OFR 5810	Quaternary Geology of the Shining Tree Area

Open File Maps	
OFM 142	Geology of the Manitouwadge–Homepayne Area
OFM 145	Geology of the Patricia Showing (1987)—Hoodoo Prospect, Keith Township
OFM 164	Geology of Foleyet and Ivanhoe Townships, Northwestern Swayze Greenstone Belt
OFM 173	Keith–Penhorwood Auriferous Deformation Zone, Northern Swayze Belt
OFM 175	Geology of Hoyle and Gowan Townships

Miscellaneous Papers	
MP 152	Report of Activities 1990, Resident Geologists
MP 156	Geoscience Research Grant Program, Summary of Research 1990–1991
MP 157	Summary of Field Work and Other Activities

Preliminary Maps	
P.3172	Precambrian Geology, Whitney Township
P.3173	Precambrian Geology, Tisdale Township

Coloured Maps	
Map 2543	Bedrock Geology of Ontario; east-central sheet
Map 2586	Shaded Image of Total Magnetic Field of Ontario, east-central sheet
Map 2555	Quaternary Geology of Ontario, east-central sheet
Map 2590	Vertical Magnetic Gradient of Ontario, east-central sheet
Map 2594	Bouguer Gravity of Ontario, east-central sheet

Airborne Electromagnetic and Magnetic Surveys	
Maps 81 388 to 81 433	Shining Tree Area
Maps 81 543 to 81 550	Partridge River Area

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

A detailed description of work done by the Ontario Geological Survey in the Timmins Resident Geologist's District is provided in the Summary of Field Work and Other Activities, Ontario Geological Survey, Miscellaneous Paper 157. Publications by the O.G.S. are listed in table 13.7.

Geology of Foleyet and Ivanhoe Townships, Northern Swayze Greenstone Belt

J.A. Ayer and M.A. Puumala began a 3 year program designed to update the geological mapping of the northern Swayze greenstone belt. Due to extensive glacial till and outwash sand cover, outcrop density is low. As a result, geological interpretation is based on data compiled from a number of sources including airborne geophysical surveys, assessment file data and diamond-drill core. The area mapped is considered to have potential for both volcanogenic massive sulphide deposits and gold deposits (Ayer and Puumala 1991).

Eastward Tracing of the Patricia Showing–Hoodoo Prospect Deformation Zone

G.M. Siragusa completed reconnaissance mapping in Keith and Penhorwood townships in an attempt to locate exposures of the Keith Penhorwood Deformation Zone (KPDZ) east of the Patricia Showing–Hoodoo Prospect area. Outcrop areas recognized as KPDZ were mapped at a scale of 1:100 and sampled for lithogeochemical studies aimed at investigating the gold potential of the KPDZ (Siragusa 1991).

Geology of Hoyle and Gowan Townships

In completing geological mapping of Hoyle and Gowan townships, B.R. Berger used a holistic approach. Outcrop in the townships mapped, as in many of the townships within the Timmins area, is less than 1%. Consequently geological mapping combined with assessment file data, the examination of diamond drill core stored at the Timmins Drill Core Library, as well as airborne geophysical survey data and information supplied by mining and exploration companies active in the map area was used in a synoptic compilation and interpretation of the geology and structure for these two townships (Berger 1991).

RESEARCH BY OTHER AGENCIES

Queen's University

Hrabi, R.B. and Helmstaedt, H. 1991. Grant 359—Structural Geology and Stratigraphic Correlations in the Midlothian Lake–Peterlong Lake Area, Abitibi Subprovince; *in* Geoscience Research Grant Program Summary of Research 1990–1991, Ontario Geological Survey, Miscellaneous Paper 156, p.31–40.

Results of a three year structural geology program are published.

University of Toronto

DeR. Channer, D.M. and Spooner E.T.C. 1991. Grant 364—Multiple Fluid-Inclusion Generations in Variably Deformed Quartz: Hollinger–McIntyre and Kerr Addison–Chesterville Archean Gold-Bearing Quartz Vein Systems, Northern Ontario; *in* Geoscience Research Grant Program Summary of Research 1990–1991, Ontario Geological Survey, Miscellaneous Paper 156, p.47–64.

Schandl, E.S., Davis, D.W., Gorton, M.P. and Wasteneys, H.A. 1991. Grant 384—Geochronology of Hydrothermal Alteration around Volcanic-Hosted Massive Sulphide Deposits in the Superior Province; *in* Geoscience Research Grant Program Summary of Research 1990–1991, Ontario Geological Survey, Miscellaneous Paper 156, p.105–120.

The Kidd Creek Deposit figures prominently in the study. Ontario Geological Survey Miscellaneous Paper 156.

University of Michigan

E. Van Hees, Department of Geological Sciences. The Formation of High Grade Gold Deposits is the subject of this PhD candidate's study which examines the Pamour, Bell Creek, Dome and Hoyle Pond deposits.

University of Saskatchewan

R. Kerrich and R. Feng continued research on the geochemistry of fine-grained clastic sedimentary rocks of the Abitibi greenstone belt.

University of Western Ontario

K. Barron continued research of the relationship of Archean gold mineralization to alkaline magmatism in the Superior Province.

Ottawa—Carleton Geoscience Centre

P. Born began a study of the Porcupine and Timiskaming metasedimentary rocks as part of a larger study of Archean Sedimentation being done in conjunction with R.J. Rice and J.A. Donaldson.

SELECTED PUBLICATIONS RECEIVED

Maurice Y.T. 1990. Program with Abstracts, 8th IAGOD Symposium in conjunction with International Conference on Mineral Deposit Modeling, 300p.

*Bannerman, H.M., 1930. Mineral Deposits of the Eastern Part of Rush River Map Area, Woman River District, Ontario; *in* Canada Department of Mines, Geological Survey Summary Report, 1928, pt.C, p.17–27.

Collings, R.K. and Andrews, P.R.A. 1983. Industrial Minerals: Problem Areas and Opportunities; Energy, Mines and Resources Canada, CANMET Report 83-5E, 46p.

Crowson, Phillip 1988. Minerals Handbook 1988–89: Statistics and Analysis of the World's Minerals Industry; Stockton Press, 338p.

*Emmons, R.C. and Thomson, E. 1929. Preliminay Report on Woman River and Ridout Map-Areas, Sudbury District, Ontario; Canada Department of Mines, Geological Survey Memoir 157, 30p.

Fulton, R.J. ed. 1989. Quaternary Geology of Canada and Greenland; Geological Survey of Canada, Geology of Canada series, no.1, 839p.

Guha, J., Chown E.H. and Daigneault, R. ed. 1990. Litho-tectonic Framework and Associated Mineralization of the Eastern Extremity of the Abitibi Greenstone Belt (Field Trip 3); 8th IAGOD Symposium Field Trip Guidebook, Geological Survey of Canada, Open File 2158, 131p.

Hattori, Keiko and Hodgson, C.J. 1990. Gold-related Geology in the Kirkland Lake and Timmins Camps (Field Trip 5); 8th IAGOD Symposium Field Trip Guidebook, Geological Survey of Canada, Open File 2160, 57p.

*Hodder, R.W. 1961. Alkaline Rocks and Niobium Deposits Near Nemegos, Ontario; Geological Survey of Canada, Bulletin 70, 75p.

Ladeira, E.A. ed. 1991. Brazil Gold '91: The Economics, Geology, Geochemistry and Genesis of Gold Deposits; *in* Proceedings of the Symposium Brazil Gold '91, p.101–108.

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14. Kirkland Lake Resident Geologist's District—1991

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INTRODUCTION

The Kirkland Lake Resident Geologist's District comprises the northern two thirds of the Larder Lake Mining Division. The Mining Division remains active, although exploration activity is somewhat down from the high levels achieved as a result of flow-through incentives (Table 14.1).

In 1991, the Kirkland Lake Resident Geologist's District faired very well in the distribution of exploration funding provided by the Ontario Prospectors Assistance Program (OPAP) and the Ontario Mineral Incentives Program (OMIP). The district had received the largest number of OPAP grants, 78 of 422 granted provincially for almost $778 084, and 35 approved OMIP grant projects totalling approximately $3.04 million.

During 1991, there were 10 active mining operations in the Kirkland Lake Resident Geologist's District: 5 underground gold mines, 1 open-pit gold mine, 2 tailings-reclamation gold producers, 1 underground industrial-minerals mine and 1 open-pit industrial-minerals mine. Other positive highlights for the year included the announcement of a very encouraging feasibility study by Hemlo Gold Mines Inc. on the Lightning Zone in Holloway Township (*see* Figure 14.1 for locations).

The year also saw 3 gold producers close, 2 of which cited the low price of gold and fixed operating costs as the reason for their closure. A strike by the miners at the Macassa Mine was narrowly averted.

MINING ACTIVITY

There were 10 producing mines within the Kirkland Lake Resident Geologist's District (*see* Figure 14.1) during 1991: 8 gold mines, 1 barite mine and 1 lizardite filler mine. Gold-production data for 1990 and 1991 are listed in Tables 14.2 and 14.3, respectively. A list of past gold-production and known-reserve figures are listed in Tables 14.4 and 14.5, respectively. Properties listed in these tables can be located on Figure 14.2.

American Barrick Resources Corporation

The Holt-McDermott Mine is located in the northwestern corner of Holloway Township. The average grade of the ore was down slightly at the beginning of 1991, yet the mine produced 60 728 ounces of gold from 655 219 tons—more than the anticipated 60 000 ounces. The average production cost was US$319 per ounce for the first 9 months of 1991.

A program to deepen the shaft began in 1990. Originally, the shaft was to be deepened to 570 m, but, due to the delineation of new reserves on the adjacent Mattawasaga property, the shaft was deepened to a depth of 620 m below surface. Drifting on the 350 m level to access this zone commenced in 1990. During the year, the mine completed 158 m of shaft sinking, 5349 m of drifting and subdrifting and 1617 m of raising. Development began on the 435 m level in 1991 by completing 539 m of development to the west and by starting drifting to the east toward the Mattawasaga Zone (M. McGill, American Barrick Resources Corp., personal communications, 1992). The zone had proven and possible reserves of 2 million tons with an average grade of 0.18 ounce Au per ton at the beginning of 1991. The mill began treating development muck from the Mattawasaga Zone during the third quarter of 1991, and the zone is expected to come into full production during 1992.

Ore from 2 near-surface zones on the Mattawasaga property were accessed by open-pit mining. The company extracted 165 000 tons of ore averaging 0.089 ounce Au per ton from a pit designed to reach a total depth of 44 m (*Northern Daily News*, March 14, 1991). The second pit hosted 110 231 tons of ore averaging 0.10 ounce Au per ton (M. McGill, American Barrick Resources Corp., personal communications, 1992).

Twenty-one workers were laid of in February, 1991, due to production constraints related to shaft sinking (*Northern Daily News*, February 15, 1991).

Deak Resources Corp.–GSR Mining Ltd.

In 1990, Deak Resources Corp. and GSR Mining Ltd. purchased the Kerr Mine and mill, located in Virginiatown. As part of the arrangements for taking over the property, Deak Resources was required to pay back taxes to the township of McGarry. A plan for repayment of the taxes was worked out and approved in August of 1991 (*Northern Daily News*, August 13, 1991, p.1).

Table 14.1. Summary of claims recorded and assessment work credit.

Year	Claims Recorded	Claims Cancel	Claims Active $	Geotech Surveys $	Physical Surveys $	Other Work $	Total Filed
1991 (June-Dec)	3130	1799	20168	993444	1155649	22070	2443697
Year	**Claims Recorded**	**Claims Cancel**	**Claims Active**	**Diamond Drilling (man days)**	**Geophysic Surveys (man days)**	**Geologic Surveys (man days)**	**Total (man days)**
1991 (Jan-May)	1659	2463	18948	40750	89987	16935	167964
1990 (Jan-May)	4170	6838	19821	100787	132394	24048	302037
1989 (Jan-May)	3511	5239	22642	154099	88288	34941	319325
1988 (Jan-May)	3885	4814	26240	209276	333274	34998	654132
1987 (Jan-May)	6742	3854	27146	197727	319836	17872	600241
1986 (Jan-May)	6973	6787	24160	107108	399511	48263	631038
1985 (Jan-May)	7558	5011	23974	95076	276646	19517	460183
1984 (Jan-May)	7943	4492	21397	93946	245542	44113	473820
1983 (Jan-May)	8354	3866	17946	121213	98366	15233	304770
1982 (Jan-May)	3253	5218	13458	99526	133511	17926	313690
1981 (Jan-May)	5498	2697	15423	69906	125459	19536	247087
1980 (Jan-May)	6299	1834	12622	64454	115031	10981	209357
1979 (Jan-May)	4261	1452	8157	29714	25352	4990	68763
1978 (Jan-May)	1710	2065	5248	32602	38100	8887	87144
1977 (Jan-May)	1826	2334	5703	37101	45436	1820	98992
1976 (Jan-May)	2350	2979	6712	47724	42338	6220	102936
1975 (Jan-May)	2916	5010	7341	45880	38047	6738	98624
1974 (Jan-May)	4757	2296	9435	40678	55716	4441	110165
1973 (Jan-May)	3260	3214	6974	34113	35811	8150	92616
1972 (Jan-May)	3253	4740	6781	39371	52351	3358	106026

In February of 1991, Deak Resources Corp. received $2.1 million from the Northern Ontario Heritage Fund for the expansion of the mill from 1200 to 2000 tons capacity per day (*Northern Daily News*, April 20, 1991). The expansion will allow the mill to accept more ore for custom milling.

Ore for custom milling came from the Francoeur Mine in Quebec, the New Buffonta Mine in Garrison Township and from the Cheminis Mine in McVittie Township.

Active exploration at and around the Kerr Mine has taken place, resulting in an increase of ore reserve figures, calculated as of July 1, 1991, to be 2.467 million tons grading 0.125 ounce Au per ton. Production from the mine totalled 35 424 ounces Au from 335 698 tons of ore. A joint venture with Kennecott Canada Inc. was announced, and 4 drill rigs were working on the surrounding properties before the end of 1991. Head grades at the mill rose steadily, thus, resulting in the company reporting a profit of $1.1 million for the first 9 months of 1991.

Deak Resources Corp.–Perrex Resources Inc.

In 1990, Deak Resources Corp. agreed to acquire Silverside Resources Inc.'s 87.5% interest in the Buffonta property in Garrison and Thackeray townships. A separate agreement between Deak Resources Corp. and Perrex Resources Inc. called for Perrex Resources Inc., holder of 6.25% of the property, to exercise its right to acquire a further 6.25% of the property from Lac Minerals Inc. and to acquire the adjacent Bambi claims. The 2 companies would then jointly explore and mine the properties.

At that time, the property had an open-pit reserve of 50 000 tons at an average grade of 0.18 ounce Au per ton with potential for underground development below the pit as well as below the adjacent, previously mined Murphy pit. Estimated reserves are 452 000 tons grading 0.15 ounce Au per ton to a depth of 400 to 500 feet. Ore was trucked to the Kerr mill in

Virginiatown, starting in December, 1990, and continuing until late March, 1991, when the operation was shut down. The mill processed 27000 tons of ore grading 0.121 ounce Au per ton.

Eastmaque Gold Mines Ltd.

Eastmaque Gold Mines Ltd. have been producing gold by processing tailings since December, 1989. On October 12, 1991, the company announced that it would be closing its Kirkland Lake operation due to low gold prices, fixed operating costs and a reduction in grade and reserves. In 1991, 14626 ounces of gold were produced from 775000 tons of tailings. Over the life of the operation, about 70000 ounces were produced from 2.7 million tons of tailings.

Extender Minerals of Canada Ltd.

Extender Minerals of Canada Ltd. produced approximately 10000 tons of barite from their mine and mill in Yarrow Township, west of Matachewan. The company is studying the possiblility of building a brake-shoe factory in Matachewan as a market for their barite (*Northern Daily News*, August 29, 1991, p.1).

Goldpost Resources Inc.– St. Andrew Goldfields Ltd.

As part of an agreement with St. Andrew Goldfields Ltd., the Hislop East (New Kelore) property was brought into production in December, 1990. At that time, reserves immediately available for mining were estimated to be 258015 tons grading 0.18 ounce Au per ton.

Gold was produced from December, 1990, until about September, 1991, when the mine closed due to low gold prices. A total of 15942 ounces of gold were produced from 84698 tons of ore for an average grade of 0.19 ounce Au per ton (*The Northern Miner*, October 7, 1991, p.20).

Hedman Resources Ltd.

Hedman Resources Ltd. produced 3433 tons of hedmanite—a lizardite mineral filler—from an open-pit mine in southern Warden Township with milling operations located in Matheson. Ore reserves to 300 feet below surface are over 10 million tons, sufficient to produce 5 million tons of filler.

Lac Minerals Ltd.

The number of ounces of gold produced at the Macassa Mine in Teck Township was down significantly from the record production of 103389 ounces in 1990. In 1991, 80808 ounces of gold were produced from 167523 tons of ore due to lower tonnages mined, lower grade and seismic activity which affected productivity. One rock burst forced the stoppage of hoisting ore for a 14 day period in October. Development work at the mine included 6000 feet of drifting and 1000 feet of raising on the 04 Zone, and 3000 feet of drifting on the 05 Zone (*Northern Daily News*, March 14, 1991).

In addition to the Macassa Mine, Lac Minerals Ltd. also produces gold from the Lake Shore Tailings operation. Tailings from the former Lake Shore Mine are being reclaimed from Kirkland Lake by an electric suction dredge. The tailings are then pumped to the Macassa Mill for processing. Production for 1991 was 13592 ounces of gold from 262076 tons of tailings.

Northfield Minerals Inc.

Initially announced as a bulk sample, Northfield Minerals Inc. began to mine the former Cheminis Mine property in late 1991. The first 2 gold bars were poured in November, 1991, at the Kerr mill in Virginiatown. During 1991, the mine produced approximately 1200 ounces of gold from 8950 tons of ore. Proven and probable reserves are sufficient for 4 years at a mining rate of 10000 to 15000 tons per month. The mine employs 45 workers.

EXPLORATION ACTIVITY

Exploration activity is down from last year. A number of properties are dormant due to the difficulties encountered by (junior) mining companies in trying to raise money for further exploration. The exploration activity for the Kirkland Lake Resident Geologist's District is summarized in Tables 14.6 and 14.7 where listings of companies, properties and explo-

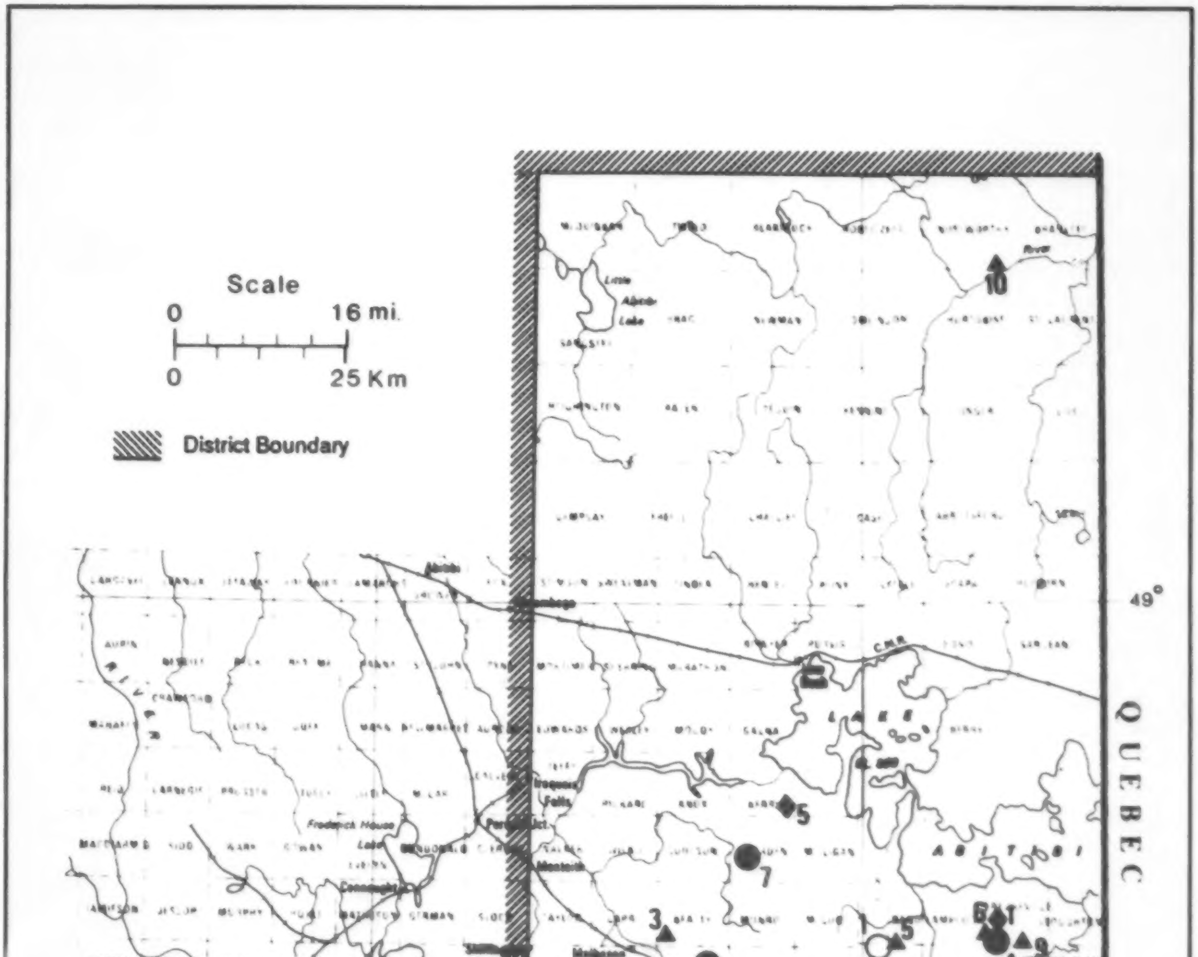
Table 14.2. Gold production in the Kirkland Lake Resident Geologist's District—1990.

Mine	Township	Ounces Produced	Tons Milled	Grade (oz./t)
Eastmaque	Teck	19865	852718	0.023
Hislop East	Hislop	4199	22784	0.18
Holt-McDermott	Holloway	59164	514312	0.12
Kerr	McGarry	10726	110777	0.097
Macassa	Teck	103389	197000	0.52
(tailings)		13885	220000	0.063
Total		211228	1917591	0.110

Table 14.3. Gold production in the Kirkland Lake Resident Geologist's District—1991.

Mine	Township	Ounces Produced	Tons Milled	Grade (oz./t)
Buffonta	Garrison	2902	26643	0.11*
Cheminis	McVittie	1200	8950	0.13
Eastmaque	Teck	14626	775000	0.019
Hislop East	Hislop	11743	61914	0.19
Holt-McDermott	Holloway	60728	655219	0.093
Kerr	McGarry	35424	335698	0.11
Macassa	Teck	80808	167523	0.48
(tailings)		13592	262076	0.052
Total		221023	2293023	0.096

* includes some 1990 production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District Boundary
QUEBEC
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Frederick House Lake
Connaught
Ramore
Swastika
Elk Lake
Earlton
Larder Lake
C.N.R.

Figure 14.1. Kirkland Lake Resident Geologist's District.

EXPLANATION

Kirkland Lake Resident Geologist's District

● Producing Mines, 1991

1.	American Barrick Resources Corp. Holt-McDermott Mine	Au,Ag
2.	Deak Resources Corp.-GSR Mining Ltd. Kerr Mine	Au,Ag
3.	Deak Resources Corp.-Perrex Resources Inc. New Buffonta Mine	Au
4.	Eastmaque Gold Mines Ltd. Kirkland Lake Tailing Project	Au
5.	Extender Minerals of Canada Ltd.	Barite
6.	Goldpost Resources Inc.-St.Andrew Goldfields Ltd. Hislop East Mine	Au
7.	Hedman Resources Ltd.	Serpentine filler
8.	Lac Minerals Ltd. Macassa Mine	Au,Ag
9.	Lac Minerals Ltd. Lake Shore Tailings Project	Au,Ag
10.	Northfield Minerals Inc. Cheminis Mine	Au

○ Advanced Exploration and Development

1.	Jonpol Exploration Ltd.-T&H Resources Ltd. Newfield Property	Au

▲ Exploration Activities

1.	Battle Mountain (Canada) Inc.-Queenston Mining Inc.	Au
2.	Deak Resources Corp.-Kennco Explorations (Canada) Ltd.	Au
3.	Glimmer Resources Inc.-Noranda Inc.	Au
4.	Granges Inc.	Cu,Zn
5.	Jonpol Exploration Ltd.	Au
6.	Noranda Inc.	Au
7.	Queenston Mining Inc.-Strike Minerals Inc.	Cu,Zn
8.	Royal Oak Mines Inc.-Queenston Mining Inc.	Au
9.	Teck Corp.-Gwen Resources Ltd.	Au
10.	Total Energold Corp.	Au

◆ Property Visits (included in text)

1. Lightning Zone
2. D. Zabudsky's Wendigo Lake Property
3. Ossian-McGarry Base Metal Showing
4. Allsopp's Eby Property
5. Milligan township Gold-bearing Boulders

Location of OGS Field Party in 1991

① Structural and stratigraphic studies in the Kirkland Lake–Larder Lake area (S.L. Jackson).

② Geology of Argyle and Baden townships (D.U. Kresz)

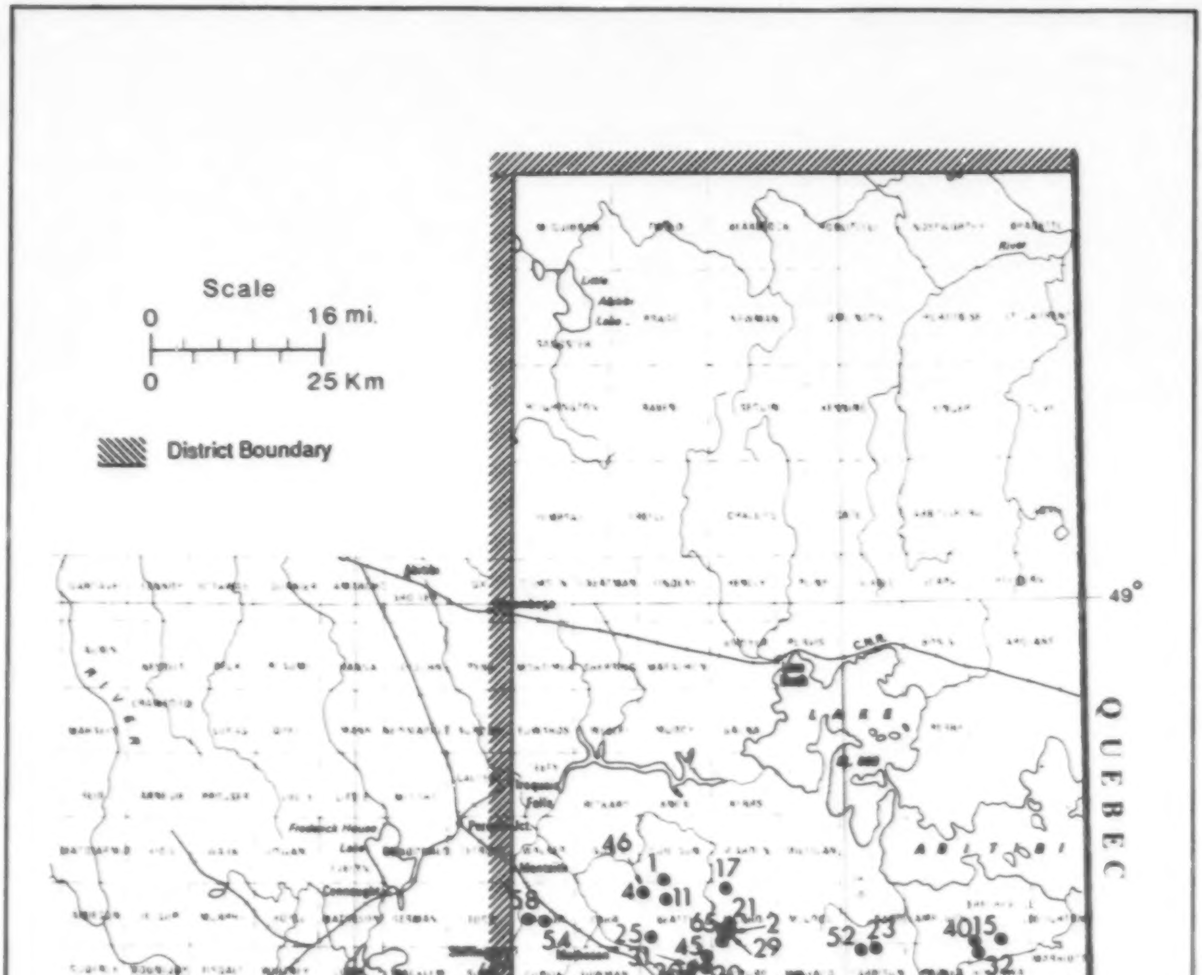
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Figure 14.2. Location of properties with past production and/or gold reserves.

Table 14.4. Past gold production in the Kirkland Lake Resident Geologist's District.

Mine	Township	Tons Milled	Prod. (oz. Au)	Prod. (oz. Ag)	Grade (oz. Au/T)	Years of Production
1. Aljo	Beatty	2333	42	5	0.02	1940
2. American Eagle	Munro	60	40	nil	0.67	1911
4. Argyll	Beatty	25	30	nil	1.2	1918
6. Ashley	Bannockburn	57076	50123	7644	0.32	1932-36
7. Baldwin	Eby	81	43	81	0.53	1929, 38
8. Barber Larder	McGarry	30118	3072	nil	0.1	1988
9. Barry Hollinger	Pacaud	267741	77000	8502	0.26	1918, 25-36, 44-46
10. Bidgood	Lebel	586367	160184	72468	0.27	1934-51
11. Blue Quartz	Beatty	500	81	33	0.16	1923, 26, 28, 34
12. Bourkes	Benoit	1298	277	50	0.21	1918, 36-38
13. Buffonta*	Garrison	96643	11902	nil	0.12	1981, 90-91
14. Canadian Arrow	Hislop	279593	17045	nil	0.06	1980-83
15. Canamax (Matheson Project)	Holloway	38765	5391	nil	0.14	1988
16. Cathroy Larder (Mirado Mine)	McElroy	89719	10231	573	0.11	1941-44, 47, 57, 87
17. Centre Hill**	Munro	327007	422	36883	0.001	1967-70
18. Cheminis*	McVittie	8950	1200	nil	0.13	1991-
19. Chesterville	McGarry	3260439	358880	19371	0.11	1930-52
21. Croesus	Munro	5333	14859	1423	2.79	1915-18, 23, 31-36
22. Eastmaque*	Teck	2679462	63231	nil	0.024	1988-91
24. Gateford (Swastika)	Teck	103684	30068	nil	0.29	1910-47***
27. Golden Summit	Maisonville	737	57	nil	0.08	1936-37, 45
28. Gold Hill	Catharine	4616	660	nil	0.14	1927-28
29. Gold Pyramid	Guibord	175	36	nil	0.21	1911
30. Hislop East*	Hislop	84698	15942	nil	0.19	1990-91
32. Holt-McDermott*	Holloway	1315301	146366	nil	0.11	1988-
33. Hudson-Rand	Teck	6496	483	143	0.07	1922
35. Kerr*	McGarry	39032791	10357999	573501	0.27	1911, 38-
36. Kirkland Lake	Teck	3140283	1172955	130579	0.37	1916-60
37. Kirkland Townsite	Teck	4230	1921	168	0.45	1958-59
38. Laguerre	McVittie	40514	7568	1383	0.19	1937-39
39. Lake Shore	Teck	17117923	8573246	1955132	0.5	1918-65, 82-87
42. Macassa*	Teck	6995358	3111584	425417	0.44	1933-
43. Macassa (tailings)*	Teck		688706	40281	0.058	1989-
44. Matachewan Consol.	Powell	3525200	378101	133210	0.11	1934-54
47. McBean	Gauthier	557621	45900	nil	0.08	1984-86
48. Miller Independence	Pacaud	31	59	70	1.9	1918
49. Moffat-Hall	Lebel	16388	4780	1149	0.29	1934-35
50. Morris Kirkland	Lebel	127253	16999	29754	0.13	1936-38, 40-42
51. New Telluride	Skead	104	62	50	0.6	1931-32
53. Omega	McVittie	1615081	214098	29290	0.13	1913, 26-28, 36-47
55. Queenston	Gauthier	1054	177	2380	0.17	1941
56. Ross	Hislop	6714482	995832	1544795	0.15	1936-89
57. Ryan Lake**	Powell	184790	1352	36141	0.01	1948-57, 62-64
59. Stairs	Midlothian	15835	3573	1767	0.23	1965-66
60. Sylvanite	Teck	5049536	1674808	337956	0.33	1927-61
61. Teck Hughes	Teck	9565302	3709007	501657	0.38	1917-68
62. Toburn	Teck	1186316	570659	135238	0.48	1912-53***
63. Upper Beaver	Gauthier	580562	140709	59167	0.24	1913-72***
64. Upper Canada	Gauthier	4648984	1398291	589696	0.30	1938-71
65. White-Guyatt	Munro	50	10	nil	0.20	1911
66. Wright Hargreaves	Teck	9934327	4821296	853643	0.49	1921-65
67. Young-Davidson	Powell	6213272	585690	131939	0.10	1934-57
Total (Gold Ore)		123910535	38791838	7621678	0.31	
Total (Tailings)			3367538	103512	0.031	

* Producer in 1991
** Base Metal Mine
*** Intermittent Production

Production figures to the end of December, 1991.

Refer to Figure 14.3 for property locations.

Table 14.5. Gold reserves in the Kirkland Lake Resident Geologist's District.

Mine/Property	Reserves (tons)	Grade (oz.Au/ton)	Ounces
Producing Mines (1991)			
13. Buffonta	452 000	0.175	67 800
18. Cheminis	256 661	0.156	40 166
22. Eastmaque (tailings)	8 400 000	0.033	277 200
30. Hislop East	835 544	0.17	142 042
32. Holt-McDermott	5 100 000	0.15	765 000
35. Kerr	2 467 000	0.125	308 375
42. Macassa	1 670 000	0.53	885 100
43. (tailings)	3 300 000	0.08	264 000
Advanced Exploration Projects			
3. Anoki	1 180 000	0.12	141 600
5. Armistice	242 224	0.175	42 389
8. Barber Larder	60 000	0.16	9 600
11. Blue Quartz	128 000	0.86	110 080
20. Creek Zone	1 118 000	0.184	205 712
23. Garrcon	350 900	0.19	66 671
25. Glimmer	1 084 373	0.338	366 518
26. Golden Harker	500 000	0.16	80 000
31. Hislop West	19 230	0.59	11 346
34. Iris	769 756	0.07	53 883
40. Lightning	5 500 000	0.27	1 485 000
41. Ludgate	650 000	0.17	110 500
45. Matachewan Consolidated	200 000	0.09	18 000
46. Maude Lake	130 000	0.158	20 540
52. Newfield	1 314 280	0.23	302 284
53. Omega	280 000	0.16	44 800
54. Porphyry	316 823	0.08	25 346
56. Ross	1 055 000	0.125	131 875
58. Shoot Zone	2 100 000	0.11	231 000
61. Teck-Hughes	400 000	0.25	100 000
64. Upper Canada	1 297 278	0.259	336 180
Total including tailings	41 177 069	0.161	6 643 007
Total excluding tailing	29 477 069	0.207	6 101 807

Refer to Figure 14.3 for property locations.

Table 14.6. Summary of Exploration in 1991, Kirkland Lake Resident Geologist's District.

Company (Township)	Work Completed	Reference
Advanced Projects		
Jonpol/T&H (Garrison)	2 800 foot drill program	NM 91/11/18, p.6
Exploration Activities		
Battle Mountain (Teck)	15 000 foot drill program	NM 91/06/17, p.A17
Deak/Kennco (McGarry)	$1 000 000 program	NM 91/09/23
Glimmer/Noranda (Beatty)	2 000 m drill program 1 800 m drill program	GRNR 91/04/17 NM 91/11/18, p.1
Granges (Currie-Bowman)	250 m drilling, geophysics	
Jonpol (Garrison)	10 000 foot drill program	NM 91/01/09
Noranda Exploration (Holloway)	feasibility study and drilling	NM 91/01/24 NM 91/02/11, p.19
Queenston/Strike (Robertson)	10 000 foot drill program 5 000 foot drill program	NDN 91/03/02 NM 91/07/08, p.20
Royal Oak (Gauthier)	25 000 foot drill program	NDN 91/01/15
Teck (Holloway)	5 000 foot drill program	NDN 91/07/22, p.3
Total Energold (St. Laurent-Hurtibise)	1 883 m drill program	

Dates in Format YY/MM/DD
NDN *Northern Daily News*
NM *The Northern Miner*
GRNR Glimmer Resources News Release

ration programs and any significant drill intersections are given. Properties can be located on Figure 14.1.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

Permanent staff of the Kirkland Lake Resident Geologist's office include: G. Meyer, Resident Geologist; H. Lovell, Regional Geologist; D. Guindon, Geologist; F.M. Boucher, Administrative Secretary; Z. Madon, Drill Core Library Geologist; and M. Gaudreau, Drill Core Library Assistant. H. Lovell, Z. Madon and M. Gaudreau are stationed at the Kirkland Lake Drill Core Library located near Swastika.

The Drill Core Library Geologist's position was vacated by D. Guindon in January when he became Geologist. M. Gaudreau and M. Leroux were seconded to the position until it was filled by Z. Madon.

H. Lovell, Regional Geologist, is nearing the completion of his Matachewan–Kirkland Lake–Larder Lake gold study. Assistance was provided by D. Robinson and A. Beecham, both on contract, and G. Durling and J. Cook, both on a Canada Employment and Immigration Commission (CEIC) Section 25 Job Creation Program.

T. Beckett, Data Geologist, worked for 5 months on contract to process assessment files.

The Mineral Deposits Inventory (MDI), which represents phase 1 of the Ontario Geoscience Exploration Database (GED) compilation program, began in mid-September, 1990, and continued until the end of March, 1991. JOMI Minerals of Kirkland Lake was contracted to update the existing Minerals Deposits Inventory for the Kirkland Lake Resident Geologist's District. Nine hundred and forty-one records were updated. Starting in January, 1992, the updating of an estimated additional 500 records is expected to take place.

Table 14.7. Significant drill intersections in 1991, Kirkland Lake Resident Geologist's District.

Company (Township)	Intersection Reported	Reference
American Barrick (Holloway)	0.22 oz./t Au/32 ft	NM 91/06/10, p.1
Battle Mountain (Teck)	0.27 oz./t Au/16 ft	NM 91/08/27, p.7
Noranda/ GoldenDragon/ Glenn Auden (Beatty)	0.25 oz./t Au/9.9 ft	NM 91/01/28
Queenston Mining (Robertson)	1.45% Cu, 0.47% Zn/30.9 ft 0.93% Cu, 5.17% Zn/14.3 ft 0.51% Cu/14 ft	NDN 91/01/24, NM 91/01/14, NM 91/01/28, NM 91/02/25, p.3

B. Blaauw and F. Legacy, both on contract, and E. Ollila and S. Young, both on a CEIC Section 25 Job Creation Program, reorganized and computerized the technical articles and government publications and maps in the library.

C. Johnson worked on the Summer Experience 1991 program as an assistant at the Kirkland Lake Drill Core Library.

A. Quibell and H. Evans completed a Futures work placement in the Resident Geologist's office. C. Backle and P. Desjardins started a similar work placement in November of 1991.

The Kirkland Lake Resident Geologist's office maintained a high level of activity, providing assistance to more than 2400 visitors. In addition, 458 enquiries were handled by the Kirkland Lake Drill Core Library. Field trips pertaining to local geology and mineral deposits were provided for exploration, government and university geologists from Canada, Finland, USA, England, Portugal, Belgium and Australia. Two field trips given by Ontario Geological Survey (OGS) geologists working in the area were organized for prospectors and explorationists interested in the Kirkland Lake Resident Geologist's District. Both were very well attended and well received. H. Lovell was trip leader for a 4 day field trip sponsored by the Geological Association of Canada, the Mineralogical Association of Canada and the Society of Economic Geologists (GAC-MAC-SEG) at the end of May, 1991. An afternoon presentation on glaciation was given to campers at Esker Lakes Provincial Park. A 1 day introduction-to-geology field trip was given to 2 local Junior Ranger camps.

In April, 1991, the 11th Annual Northeastern Ontario Regional Geoscience Seminar was hosted by the Kirkland Lake Resident Geologist's office at the Northern College of Applied Arts and Technology in Kirkland Lake. The 2 day event was well received with an attendance approaching 300 to view the 59 poster displays and listen to 8 oral presentations by industry and government geoscientists. The format was modified somewhat this year to allow more time to view the poster displays. Nineteen of the poster displays were provided by individuals or companies associated with the mining and exploration industry or the universities.

Seven active exploration projects and 2 operating mines were visited by the Resident Geologist and his staff. Poster sessions were presented at both the Northeastern Ontario Regional Geoscience Seminar and the Ontario Mines and Minerals Symposium in Toronto. A series of posters, depicting the exploration and mining sequence, was presented as part of an Open House at the Kirkland Lake Drill Core Library as part of Mining Awareness Week in Ontario.

A 3 day Prospectors' Course was given by D. Guindon and G. Meyer in July, 1991.

A number of minerals-potential evaluations and mine-hazard evaluations were reviewed for the purpose of property rezoning at the request of the Ontario Ministry of Municipal Affairs.

A crew of 14 Junior Rangers, based at Esker Lakes Provincial Park, upgraded popular field trip stops by stripping overburden and bleaching outcrops.

A data base listing the names and addresses of companies and individuals offering services to the mining and/or exploration industry in the Kirkland Lake area is being established. Individuals or companies offering services are invited to participate in the creation of this data base by completing a questionnaire which is available at the Resident Geologist's office. Your co-operation in both the creating and periodic updating of this data base is greatly appreciated. Companies requiring any of 32 presently listed services locally can receive a listing of the companies or individuals providing these services.

PROPERTY VISITS

Lightning Zone

The Hemlo Gold Mines Inc. and Freewest Resources Inc. joint-venture project in Holloway Township—owned 60% and 40%, respectively—hosts the upper section of the Lightning gold zone. The zone's downdip extension to the south is owned by a joint venture comprising Hemlo Gold Mines Inc. (51%), Freewest Resources Inc. (34%) and Newmont Mining Corp. (15%) which can collectively earn a 70% interest in the adjacent Teddy Bear Valley Mines Ltd.'s Harker–Holloway property. Teddy Bear Valley Mines Ltd. was the subject of a proxy fight, and ownership in the company is uncertain with the recent discovery of a syndicate-unit-holder list which may affect a 1984 reorganization deal.

The Lightning Zone has been traced in an easterly direction for a strike length of 2600 feet. The ore zone dips steeply to the south, and the plunge has now been interpreted to be at a steep angle. The top of the deposit, previously interpreted as the plunge of the deposit, has a shallow dip to the east.

The gold is associated with fine-grained, disseminated pyrite that occurs in distinctive grey, siliceous, hydrothermally altered, stratiform mafic volcanic rocks located at the contact with an ultramafic unit. Remnant varioles and textures typical of hyaloclastite are pervasive and are well preserved in the less-altered nearby mafic volcanic rocks. The alteration zone extends to surface in the plane of gold mineralization as greyish-yellow sericite-carbonate alteration, locally with minor siliceous sections containing minor pyrite and anomalous gold values. The continuation of hydrothermal alteration in the plane of gold mineralization suggests that gold and silica precipitated from the hydrothermal solution within a favourable temperature-pressure range. A naturally permeable medium, occurring as either an "open" fracture zone or an "open" rock texture such as hyaloclastite prior to complete diagenesis, must have existed to allow the hot aqueous solutions to pass. The original chemical and mineralogical compositions of the rocks would also affect the final rock composition and mineralogy resulting from the hydrothermal-alteration process. The top and bottom of the favourable temperature–pressure range were likely horizontal and near parallel to the surface of the earth at the time of formation. The top of the gold zone, now dipping shallowly to the east, is perhaps indicative of tilting of a previously horizontal zone. This may suggest that other gold deposits which may have formed nearby and on strike with the Lightning gold zone would occur closer to surface to the west and at greater depth to the east.

The results of the long-awaited feasibility study on the Lightning Zone (Hemlo Gold Mines Inc.) were finally released. Reserves have been boosted to 5.5 million tons grading 0.27 ounce Au per ton. The rate of return is estimated at 17.9% based on a US$375 gold price per ounce, an $80 million capital cost and a 1654 tons-per-day mining rate. Estimated production costs are US$180 per ounce, and production could start by the end of 1994. Hemlo Gold Mines Inc. intends to proceed with an underground exploration-and-development program on the zone to verify reserves before making a production decision. The work will not begin until Hemlo Gold Mines Inc. establishes an acceptable deal with all parties that are concerned with the various properties to create a single mine property (*The Northern Miner*, October 7, 1991, p.1). Exploration on the zone was temporarily stopped due to an ownership dispute (*Northern Daily News*, October 22, 1991, p.3).

D. Zabudsky's Wendigo Lake Property

Three copper occurrences were examined immediately northwest and west of Wendigo Lake in Marter Township. The showings are in the Gowganda Formation and occur at the western extremity of a stream-sediment base metal anomaly (*see* discussion on Volcanogenic Base Metal Potential, this report).

The first copper occurrence is located approximately at Universal Transverse Mercator (UTM) Zone 17, 592500E 5303925N. A 5 foot thick diabase sill, striking 120° and dipping 10° to 15°W, cuts the mudstone country rock. The diabase contains numerous chalcopyrite, bornite and pyrite stringers and blebs mainly along joint planes within and especially along the margins of the intrusion. Locally, minor quartz veining is associated with sulphide minerals, and hematite occurs in several locations.

The second copper occurrence is located approximately 200 m north of the first. The host rock at this site consists of clast-supported, well-rounded, polymictic conglomerate with cobbles up to 10 cm in diameter. Cobbles and pebbles constitute approximately 50% of the rock. The clasts are set in a gritty matrix. Chalcopyrite blebs up to 2 mm in diameter together with small chalcopyrite stringers are disseminated throughout the matrix. Several granodiorite cobbles and pebbles contain up to 5% evenly disseminated chalcopyrite. Close examination of the texture suggests that chalcopyrite is likely replacing sericite. It appears from the above textural and mineralogical relationships that hydrothermal activity, likely caused by the emplacement of the Nipissing diabase sills, redistributed the chalcopyrite. For the possible origin of the chalcopyrite and other base metals, the reader should refer to the discussion entitled Volcanogenic Base Metal Potential later in this report.

The third copper occurrence is located at approximately UTM Zone 17, 592400E 5303270N. Here, a quartzite outcrops in several areas and contains evenly disseminated, minute specks of chalcopyrite. If this chalcopyrite is also the product of hydrothermal redistribution, then the finer-grained material, which comprises the quartzite, was also of a pervious nature and it would consequently control the grain size and distribution of the observed chalcopyrite mineralization.

Ossian-McGarry Base Metal Showing

A small zone of dalmatianite measuring 200 by 250 feet occurs within andesite in the northwestern corner of McGarry Township on Claim L1146394 belonging to L. Cunningham. The zone is located at UTM Zone 17, 602350E 5337350N. This zone contains considerable base metal mineralization, including evenly distributed pyrite, local small sulphide pods containing up to 10% sphalerite stringers, occasional chalcopyrite blebs, and minor amounts of molybdenite occurring along some joint planes.

The alteration appears similar to that underlying volcanogenic massive sulphide (VMS) mineralization at the Waite-Amulet Mine in northwestern Quebec. The spots within the dalmatianite zone, constituting 20% to 40% of the rock, generally consist of cordierite, but some are represented by vesicular fillings of plagioclase. The spots are ovoid, circular or irregularly shaped and range from a few millimetres to about 2 cm in diameter (Fraser 1973).

Diamond-drill core indicates that the alteration zone occurs as a flat sheet about 60 feet thick dipping at 25° to 35°S.

Top determinations made from pillow orientations suggest that stratigraphic tops are to the east. Approximately 1000 feet to the east, a banded, siliceous zone trends in a northeast direction for a minimum distance of 2000 feet and ranges from a few inches to 50 feet in width (Fraser 1973). The zone dips 80° to 85° to the southeast and contains up to 5% pyrite and traces of chalcopyrite and pyrrhotite. The unit probably represents a chemical sediment and occurs at a higher stratigraphic level than the dalmatianite-alteration zone. The banded siliceous unit is overlain by dacite which appears to be part of the base of the Blake River Group.

The base-metal-bearing dalmatianite-alteration zone is possibly part of a feeder system to a massive sulphide zone that may occur at the siliceous zone. If the stratigraphy is overturned, then further exploration is warranted to determine where the dalmatianite zone intersects the siliceous zone. Such a location would likely be the site where one might expect a volcanogenic massive sulphide deposit to occur. Considering the stratigraphic positions of both the Ossian base metal showing and Robertson Township base metal deposit, one would expect them to be more or less coeval.

A. Allsopp's Eby Property

The property owned by A. Allsopp, consisting of 9 claims, straddles the boundary between Eby and Otto townships and is located approximately 2 km south of the northeastern corner of Eby Township. The site is located at UTM Zone 17, 563625E 5325620N (point location at the Cheltonia shaft).

The property has a long exploration history dating back to the 1930s when considerable work was done by Cheltonia Mines Ltd. A shaft was sunk to a depth of 112 feet, and 7 surface diamond-drill holes were completed. Several high gold and copper values were reported in samples from drill core. In the late 1940s, the Todora Kirkland Prospecting Syndicate restaked the property. In a critique of the work performed by the previous owners, N.E. Nelson in a memorandum dated July 16, 1948, suggested that circumstantial evidence indicated that previous results were unreliable (File KL-2701, assessment files, Resident Geologist's office, Kirkland Lake). Macassa Mines Limited optioned the Todora property and completed 3 diamond-drill holes in 1952. Assay results did not return any significant gold or copper values.

Three mechanically dug trenches 300 feet apart were completed in 1991 by the present owner and are located approximately 1000 feet west of the Cheltonia shaft. Each trench extends northwards from the base line of a cut control grid and, starting from the west, these trenches are 800, 900 and 450 feet long on lines 12+00W, 9+00W and 6+00W, respectively.

Rock exposures in the trenches are mainly mafic volcanic rocks with interlayers from south to north of graphite shale and a silica-rich zone. The siliceous zone, approximately 100 feet wide, is exposed on line 12+00W between stations 7+00N and 8+00N and on line 9+00W between stations 6+00N and 7+00N. This rock unit tends to be finely banded with pyrite disseminated throughout. W. Benham of Battle Mountain had 3 samples analyzed from this zone for their gold content, and the highest value obtained for these samples is 58 ppb. Further sampling of this zone is warranted. Whole-rock analyses should also be done to test for possible chemical evidence of hydrothermal alteration associated with volcanogenic massive sulphides. The silica-rich, pyrite-bearing zone is similar in appearance to Battle Mountain (Canada) Inc.'s 102 Gold Zone on their Amalgamated Kirkland property just south of Kirkland Lake.

A 30 foot wide, black, pyrite-bearing, argillaceous sedimentary unit occurs at line 9+00W from stations 3+00N to 3+30N and at line 6+00W from stations 2+30N to 2+60N. A sample taken from this unit by Battle Mountain (Canada) Inc. returned 123 ppb Au.

Several jasper-magnetite-layered nodules up to 1 foot in diameter occur in mafic volcanic rocks in a trench located at line 12+00W from stations 2+75N to 8+00N. The arrangement of some of the nodules suggests a high degree of deformation, possibly of a single narrow iron formation band.

At line 9+00W and station 1+35N, a quartz-stringer zone, several feet wide, contains from 5% to 30% quartz-vein material. The orientation of the quartz veins is highly variable, however, the overall strike direction is 080°. Locally the mafic volcanic country rock is brecciated and cemented by the quartz veins. The quartz veins contain locally well-developed chalcopyrite blebs; some of the chalcopyrite-bearing quartz-vein material should be analyzed for gold.

A carbonate-chlorite-bearing alteration zone occurs on line 12+00W from stations 0+50N to 1+00N. Two intrusions are also exposed in the trenches and are represented by a minor, discontinuous syenite body on line 6+00W at station 2+40N and gabbro on line 9+00W just south of the 0+00 base line.

Milligan Township Gold-bearing Boulders

The gold-bearing quartz boulders found in 1965 on the surface of the Munro Esker in Milligan Township are intriguing. They are near Eastford Lake in the northwestern corner of the township. Five distinct boulder sites were originally identified. The boulders range from 0.5 to 1.5 m in diameter and contain little to no sulphide minerals. Gold assays range from trace to 0.94 ounce Au per ton (Ferguson and Freeman 1978). Due to recent road construction, the best method to find the boulders is by locating the landing on Eastford Lake and then driving back southward approximately 2000 feet.

The site was visited to examine and sample the previously discovered auriferous-quartz boulders. Site 5 of Ferguson and Freeman (1978) is located approximately 20 feet east of the access road to Eastford Lake from Highway 101. Three boulders were found at this site to be differing from each other as follows: one comprised white quartz, the second white quartz with sulphides and the third blue quartz. Two other boulders were located approximately 500 feet west-southwest of Site 5, one of which contains bands of sulphide minerals. The gold content of the 5 boulders sampled ranges from 0.034 to 0.511 ounce Au per ton and averages 0.188 ounce Au per ton based on 5 analyses. Large (greater than 1.5 m diameter) boulders of pillowed basalt flows occur in close proximity to the quartz boulders. Other boulders on surface are much smaller, are of varying lithologies and are not considered to be related to the source of the gold-bearing quartz boulders. Polished sections will be made to determine sulphide mineralogy and to look for telluride minerals.

Gold and gold-silver telluride minerals were identified in a heavy-mineral concentrate made from an esker-sand sample collected approximately 1 mile to the north (Guindon 1982). Bay Resources and Services Inc. collected over 1100 one-cubic-foot C-horizon soil samples in a 26 claim area around Eastford Lake. The samples were sluiced over a knobby rubber mat to produce a gravity concentrate, and magnetite was removed with a magnet. Company staff reported finding some silvery grains—along with gold grains—which they thought may have been platinum but which are probably tellurides since tellurides are often silvery in colour. They also noticed a variation in silver content of gold grains based on colour (File KL-0881, assessment files, Resident Geologist's office, Kirkland Lake).

Much work has been done to identify the source of the boulders. Companies have studied the chemistry of the quartz boulders, the surrounding boulders and the mineralogy and lithology of the surrounding matrix material. Glacial fluting and till- fabric studies suggest that the boulder source is to the northeast, possibly originating from a bedrock topographic-high area northeast of Bear Lake in Kerr Township. Seismic work and follow-up overburden drilling indicate that the esker does not follow a bedrock depression—at least not in this portion of the esker. Some interesting gold-grain counts and textures were found in samples from some of the overburden drill holes (*see* File KL-0199, assessment files, Resident Geologist's office, Kirkland Lake). Gold-assay results from reverse-circulation drilling, with the drill rigs having been sited along on an easterly trend across Bear Lake, do not appear to support the hypothesis that the source of the auriferous quartz boulders is to the northwest of the lake (*see* File KL-0689, assessment files, Resident Geologist's office, Kirkland Lake).

A compilation of the present data available should narrow the favourable areas for follow-up work (*see* also files KL-1362, KL-0881 and KL-0661, assessment files, Resident Geologist's office, Kirkland Lake).

DRILL CORE STORAGE PROGRAM

The Kirkland Lake Drill Core Library is responsible for maintaining representative drill core for the Larder Lake Mining Division. The Larder Lake Mining Division includes all of the Kirkland Lake Resident Geologist's District and the northern part of the Cobalt Resident Geologist's District.

The Kirkland Lake Drill Core Library collects, catalogues and preserves drill core, rock samples, pulps and rejects from exploration programs which have been conducted throughout the area. The drill core is available for public viewing and sampling. A variety of equipment is available at the drill core library and includes the following: binocular microscope, microscope with transmitted and reflected light capabilities, ultraviolet lamp, scintillometer, drill core splitters and rock saws.

The library increased its collection of drill core by 10 246.8 m representing 12 229.6 m of drilling. A summary of the new drill core donated to the Kirkland Lake Drill Core Library since November 15, 1990, is tabulated in Table 14.8. Figure 14.3 illustrates the drill hole locations for all the drill core donated to the Kirkland Lake Drill Core Library up to December 15, 1991.

Over the last 7 years, a cumulative total of 184 291.5 m of drill core representing 282 688.4 m of drilling from 2134 diamond- drill holes has been donated to the drill core library (up to December 15, 1991). Of this total, 116 848.6 m of drill core representing 204 061.8 m of drilling from 1544 holes are stored inside at the facility itself while 67 442.9 m of drill core representing 78 626.6 m of drilling from 590 holes are stored outside at the Swastika Tree Nursery. Material collected from an additional 155 rotasonic overburden holes is stored both at the library and at the tree nursery. Inside drill core storage is filled to 91.2% of capacity.

A concerted effort by the drill core library staff to acquire type sections of past- and present-producing mines as well as from significant mineral occurrences is presently underway. Most drill core obtained through this initiative will be stored inside the drill core library facility. Less-significant and/or repetitive drill holes will be transferred to outside storage facilities to make room for this new drill core.

A program that was initiated last year to collect and document representative rock samples from the Kirkland Lake Resident Geologist's District is continuing.

The practice of telescoping or condensing drill core no longer exists at any of the drill core library facilities in the province.

RECOMMENDATIONS FOR EXPLORATION

Volcanogenic Base Metal Potential

The Kirkland Lake Resident Geologist's District, located between the 2 highly productive volcanogenic base metal camps of Timmins and Noranda, has had only limited copper and zinc production. The Potter Mine in Munro Township is the only volcanogenic massive sulphide (VMS) past producer in the Kirkland Lake Resident Geologist's District. The mine milled 600 000 tons of ore with an average recovered grade of 2.05% Cu and 1.67% Zn.

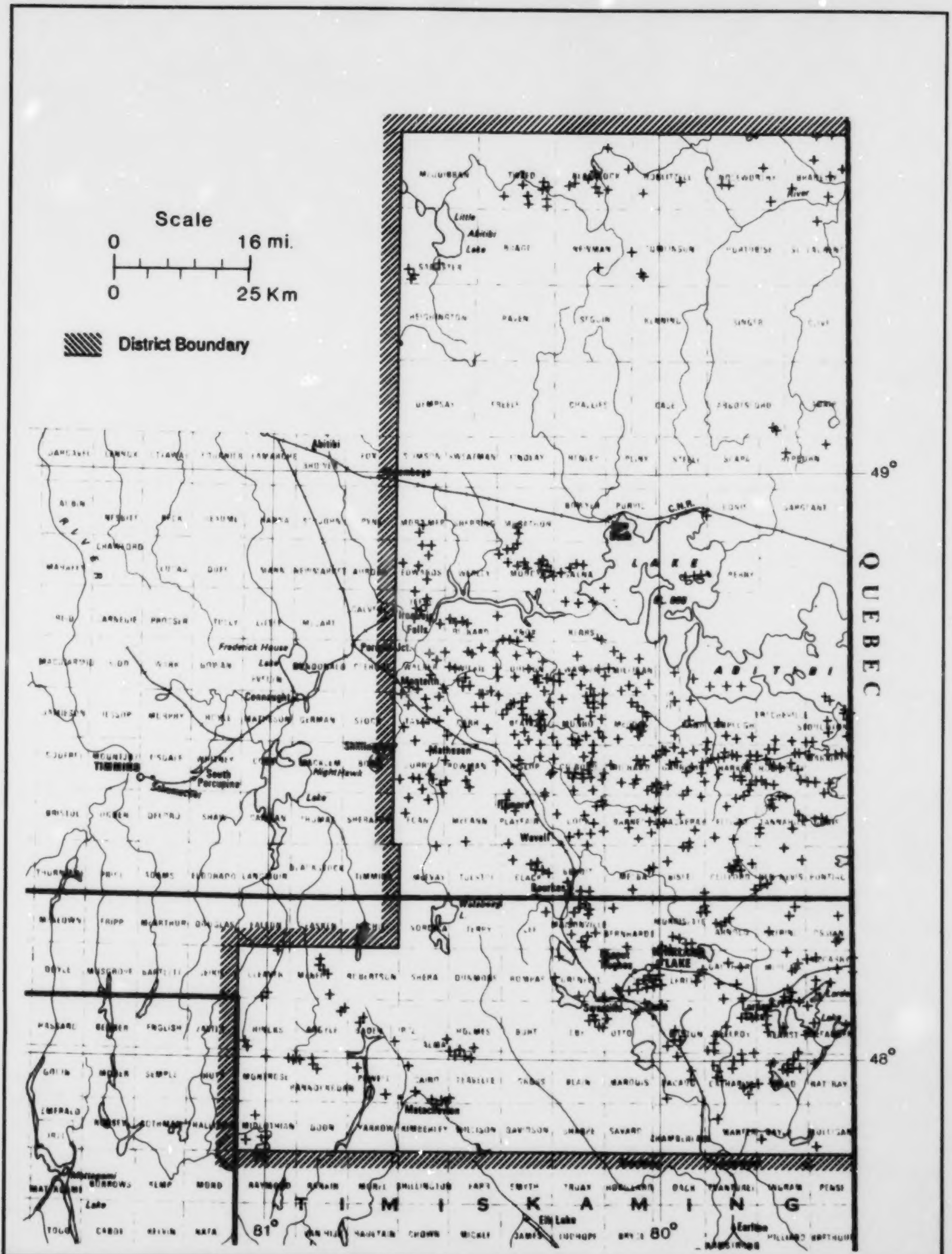

Scale
0
16 mi.
0
25 Km
District Boundary
Little Abitibi Lake
Abitibi
Frederick House Lake
Connaught
Timmins
South Porcupine
Schumacher
Night Hawk Lake
Iroquois Falls
Matheson
Ramore
Wavell
Bourkes
Kirkland Lake
Matachewan
Elk Lake
Earlton
Englehart
Larder Lake
Gowganda
River
C.N.R.
LAKE
ABITIBI
QUEBEC
49°
48°
81°
80°
TIMISKAMING

Figure 14.3. Location of drill holes stored at the Kirkland Lake Drill Core Library.

Table 14.8. Summary of drill core collected since November 15, 1990, Kirkland Lake Resident Geologist's District.

Township	Number of holes	Total Depth (m)	Core Stored (m)
Abbotsford	3	306.9	248.0
Argyle	1	73.2	71.3
Bannockburn	1	233.8	231.3
Ben Nevis	4	140.9	140.9
Black	7	519.3	418.7
Boston	1	211.2	208.8
Cairo	2	156.9	128.0
Catharine	7	1092.2	957.6
Eby	1	156.2	154.4
Elliot	3	281.6	229.8
Harker	4	593.1	449.7
Hearst	1	121.9	1.8
Hepburn	1	256.0	255.1
Holmes	4	253.9	230.9
Knox	3	307.3	261.9
Lebel	2	263.0	239.9
Marter	2	98.5	98.5
McGarry	1	497.0	471.0
McNeil	6	611.1	599.5
McVittie	11	2185.7	1780.1
Moody	4	744.3	312.8
Morrisette	1	91.7	89.6
Mortimer	1	45.7	45.7
Mulligan	1	61.3	60.4
Otto	1	131.4	130.5
Pacaud	3	281.0	267.0
Playfair	2	152.4	126.2
Powell	7	1631.5	1581.7
Rickard	3	405.7	198.4
Teck	2	224.0	189.3
Warden	1	100.9	68.0
Total	91	12229.6	10246.8

Two volcanogenic massive sulphide deposits, both stratigraphically underlain by stringer-sulphide zones, were discovered within the past 3 years. These discoveries, by Tundra Gold Mines Ltd. near Winnie Lake in Teck Township and both Queenston Mining Inc. and Strike Minerals Inc. in Robertson Township, have provided considerable encouragement to companies exploring in the district.

KINOJEVIS–BLAKE RIVER GROUPS CONTACT

The Kinojevis Group of volcanic rocks consist essentially of alternating iron-rich and magnesium-rich tholeiittic flows. On a regional scale, airborne-magnetometer surveying has revealed that these flows are characterized by alternating bands of magnetic highs and lows. The Kinojevis Group is stratigraphically overlain by the Blake River Group which consists of mafic to intermediate calc-alkalic flows and pyroclastic rocks. This latter group is characterized by a low magnetic response and is distinctive on airborne-based magnetic-field surveys as an area of low magnetic- field relief. The 2 volcanic groups geographically cover at least 2 large areas—one north of Kirkland Lake between highways 66 and 101 and the other northwest of Matachewan. It appears, in both cases, that the 2 groups are folded on a regional basis, forming a major syncline with a shallow, east-plunging fold axis.

The Robertson Township base metal discovery occurs at the stratigraphic top of the Kinojevis Group and bottom of the Blake River Group. Although VMS deposits commonly occur at the stratigraphic top of pyroclastic rocks, the Robertson deposit is underlain essentially by alternating magnesium-rich and iron-rich tholeiitic flows. An alteration zone with widespread sulphide mineralization appears to form a halo in the stratigraphically underlying volcanic rocks. A silica-rich, fine-banded chemical sediment has been observed in at least 2 locations at the contact of the Kinojevis and Blake River groups. At the Robertson base metal occurrence, the chemical sediment is pyrite-chalcopyrite-sphalerite bearing, while at the other site in Baden Township, at the Great Northern Bend of the Montreal River, it is barren of sulphide minerals. If such a siliceous zone is widespread along the Kinojevis–Blake River groups contact then it could serve both as a marker horizon and as a horizon favourable for base metal deposits.

Numerous base metal occurrences are distributed close to the southern Kinojevis–Blake River groups contact, stretching from McGarry Township, in the east, to Benoit Township for a total distance of approximately 50 km. No known base metal showings occur along the contact on the northern side of the syncline, possibly due to the lack of outcrop and the relatively poor road access.

The detection of hydrothermal alteration, such as soda depletion and magnesium enrichment, through rock-geochemistry investigations could locate areas of high base metal potential. In areas with siliceous chemical sediments, an increase in the sulphide content may be a further indicator. It may be worthwhile to attempt to identify a possible fracture and/or fault pattern that could have controlled centres of base metal formation prior to deposition of the Blake River Group. Scott (1980) postulates that the distribution of Kuroko VMS deposits in Japan and the Noranda VMS deposits in Quebec were controlled by 2 fault and/or fracture grids intersecting more or less at right angles to one another.

ALTERATION ZONES IN THE BLAKE RIVER GROUP

Rock-geochemistry studies by Wolfe (1977) and Grunsky (1986) identified areas of hydrothermally altered volcanic rocks with enrichments in base metals. What appears to be feeder systems for several VMS deposits have been identified and they suggest that another favourable horizon occurs near the top of the Blake River Group. At present, it is not known if protective cover rocks, along with possible massive sulphide zones, have been eroded away. Considerable folding has occurred, and one might expect preservation of a favourable horizon in at least some areas below the present erosion surface.

STREAM-SEDIMENT BASE METAL ANOMALY IN BAYLY TOWNSHIP

A base metal anomaly was identified in stream sediments (Hornbrook and Friske 1988; Friske, Bath and McCurdy 1990; and Meyer et al. 1991) centred on the boundary of Bayly and Ingram townships. In this area, widespread chalcopyrite, sphalerite and galena showings occur in the Gowganda Formation of the Huronian Supergroup. Disseminated chalcopyrite mineralization (*see* discussion D. Zabudsky's Wendigo Lake Property *in* section "Property Visits", this report) displays replacement characteristics. It is thought that hydrothermal activity was caused by the emplacement of the Nipissing diabase sill. The replacement characteristics and widespread dissemination of chalcopyrite suggests previous permeability in at least some of the Huronian Supergroup's sedimentary layers.

During the time of deposition of Huronian Supergroup sediments, the Archean rocks had already undergone diagenesis and were essentially impermeable to hydrothermal fluids with the exception of shear, fracture and breccia zones. Thus, the base metals could not have been derived directly from the underlying Archean volcanic rocks. It is instead postulated that during Huronian time, Archean rocks, including VMS deposits, were eroded, and the erosional products were transported and deposited primarily by fluvial sedimentation to the south. Under these circumstances, one would expect heavy minerals to form concentrates near the base of pre-Huronian valleys.

Subsequently, Nipissing Diabase intruded into porous Huronian Supergroup sediments causing widespread hydrothermal alteration and the redistribution of base metals. As a consequence of the redistribution of base metals, it is not known where in the Huronian Supergroup stratigraphy the dispersed base metals existed at the time of diabase intrusion. This could be significant, since it might indicate the ultimate Archean source. If the dispersed base metals occurred at a higher Huronian Supergroup stratigraphic level, then the source would have been distal—perhaps the Noranda base metal camp and/or the Ben Nevis Township area. At the latter area, the evidence for volcanogenic massive sulphides is restricted to hydrothermal-alteration zones. If dispersed base metals were remobilized from the base of the Huronian Supergroup sediment filled valleys, then the Archean source could be nearby, possibly even from the stratigraphic top of the so called Archean Skead volcano. The top of this volcano is likely located under the Huronian Supergroup cover rocks somewhere between the stream-sediment base metal anomaly and the area where the top of Skead Group volcanics outcrop 15 km to the north. The Proterozoic sedimentary rocks filling the so called Silverfields Trough, south of Cobalt, may give some clues as to the type of base metals mineralization that one may possibly also expect to occur at the base of valley-filled sedimentary rocks of the Huronian Supergroup north of the Bayly Township river-sediment base metal anomaly. At the Silverfields Trough, most of the base metals sulphide boulders, cobbles and pebbles in conglomerate are chalcopyrite. Galena and sphalerite in the conglomerate are present principally as rims around the chalcopyrite clasts. Most of the sphalerite and galena occur in mudstone stratigraphically above the basal conglomerate. These minerals occur in distinct laminae parallel to bedding. Although some mineralogical relationships suggest redistribution of sulphides, the sulphides were likely emplaced as detrital material prior to the intrusion of Nipissing Diabase (Lovell 1978; H. Moore, personal communication, 1989).

To explore for a possible, nearby, indirect Archean source for the Huronian sediment-contained sulphides, it is recommended to explore the stratigraphic top of the so-called Archean Skead volcano for possible VMS. Tops are continuously to the east over a section of at least 16 km. The sequence of volcanics is topped with fragmental felsic volcanic rocks occurring as huge inclusions up to 1 km in length within mafic intrusions north and east of St. Anthony Lake (Jackson et al. 1990). Judging by the configuration of the volcanic pile, the thickest section is covered by Huronian sediments just north of the stream-sediment base metal anomaly. The Huronian Supergroup sediment cover is a major obstacle to conventional base metal exploration methods. It is recommended to perform a lithogeochemical survey of the fragmental volcanic rocks immediately west of the Huronian Supergroup sediments to search for evidence of hydrothermal alteration. Absence of such a zone should, however, not be considered a deterrent; sampling points may be simply too distant from the stratigraphic top of the felsic volcanic pile. Regardless of lithogeochemical results, EM surveys with deep penetration are required to search for base metals below the Huronian Supergroup sediments.

Anomalously high mercury-vapour values have been detected in soil air more or less vertically above deep seated, "blind" base metal deposits in the Noranda area, Manitoba and other parts of the world (Fursov 1990; Fedikow and Amor 1990). Considering the general permeability of the Huronian Supergroup sediments, then mercury surveys may also prove to be a useful tool in this challenging environment.

DRILL CORE LIBRARY RESEARCH

A wealth of information can be obtained from sampling and analyzing drill core stored at the Kirkland Lake Drill Core Library. Base metal deposits are known to have hydrothermal-alteration zones which can be recognized by their diagnostic geochemical features such as Na_2O depletion and MgO and FeO enrichment. Alteration zones are usually substantially larger than their associated VMS deposits. Discovery of such alteration in conjunction with stratigraphic top determinations could lead to the identification of narrow horizons with high base metal potential. To date, this type of research has not been conducted on drill core stored at the Kirkland Lake Drill Core Library.

Gold Potential

ARCHEAN LODE-GOLD DEPOSITS

The discovery by Noranda Inc. of the Lightning gold zone in Holloway Township—with the top of the deposit being nearly

300 m below surface—is a major breakthrough for the exploration of "blind" gold deposits. Noranda identified a geological setting favourable for gold deposits and diamond-drill tested, to a greater depth, a previously known sericite-carbonate-rich alteration zone. The alteration zone which comes to surface is apparently in the same plane as the gold-bearing zone and locally contains minor sections of silicified rock containing small amounts of pyrite and anomalous gold values. The gold zone is characterized by silicification and the formation of pyrite which apparently contains most of the gold.

Undoubtedly, the Archean lode-gold deposits were formed by high temperature hydrothermal systems. At a specific temperature-pressure range (possibly the boiling point), silica and gold precipitated forming the gold zones. Such a hydrothermal system would require either a permeable medium, such as hyaloclastite, pumice, conglomerate or similar lithology prior to complete diagenesis, or open fractures, breccia zones, shear zones or similar such environment. In the case of open fractures, quartz veins would develop from the walls inwards and reaction with the wall rocks would be minimal. Where hydrothermal solutions pass through rock via a maze of minute conduits, extensive hydrothermal alteration occurs. A complex interaction between the hydrothermal solutions, which themselves have differred in chemistry from one site to another, and the chemistry, mineralogy, permeability and solubility of the host rock determine the final ore type formed. The gold zones in this type of deposit are characterized by silicification and preservation of some original rock textures. Of greatest significance, for exploration purposes, is the recognition of continued hydrothermal alteration above and in the general plane of such gold-mineralized zones. At the Lightning Zone, this alteration zone requires thorough research to determine other diagnostic mineralogical and geochemical features which might indicate a favourable zone for blind gold mineralization. The favourable temperature-pressure range for hydrothermal gold deposition must have been related to the earth's surface. With subsequent deformation and given the present erosion surface, some gold deposits would have been eroded away while others would occur at or below the present erosional surface.

TILL ARSENIC-GOLD-ZINC ANOMALY, MUNRO TOWNSHIP

A reconnaissance backhoe till-sampling program (McClenaghan 1990) identified a coincident arsenic, gold and zinc anomaly centred more or less near the Croesus Gold Mine—a mine which has produced 14 859 ounces of gold from 5333 tons milled at an average recovery grade of 2.7 ounces Au per ton. The overburden anomaly measures approximately 5 by 3 km and has only been partially delineated. At the Croesus Mine, the gold, which was essentially confined to a 200 feet long by 2.5 feet wide quartz vein, appears to have a close genetic relationship with arsenopyrite (Lovell and Ploeger 1977). The coincident gold and arsenic till anomaly stretches well beyond the small mine area and in an up-ice direction. Thus there is excellent potential for the discovery of other arsenopyrite-associated gold deposits to the north, east and west of the Croesus Mine. Elevated zinc values may have been derived from either the Potter Mine base metal horizon, located several kilometres to the north, or other presently unrecognized bedrock sources.

DRILL CORE LIBRARY RESEARCH

Since hydrothermal-alteration zones associated with gold deposits at greater depth are recognizable in drill core, it is recommended that explorationists review and sample drill core which may have such potential at the Kirkland Lake Drill Core Library.

RECOMMENDATION FOR UNIVERSITY RESEARCH

Extensive drilling of diamond-drill holes on the Noranda-Freewest property has delineated a hydrothermal alteration zone which can be traced in the plane of the Lightning gold zone to the surface. The alteration zone continues nearly 300 m above the ore body and likely continued for a considerable distance above the present erosion surface. This situation appears to demonstrate that hydrothermal alteration continued beyond the range where silica and gold precipitated. The mineralogy and chemistry of the alteration zone need to be thoroughly researched to define diagnostic features that can be applied elsewhere to locate "blind" gold deposits. Such a study may have a major impact on the search for gold deposits and greatly increase the success rate for discoveries.

MATACHEWAN CONSOLIDATED MINES, LTD. TAILINGS SPILL

As reported last year, an unattended tailings dam belonging to Matachewan Consolidated Mines, Ltd. broke on October 17, 1991, spilling tailings into Davidson Creek which flows into the Montreal River. The mine closed in 1954. The spill was due to unusually high water levels in Otisse Lake caused by a combination of heavy rains and beaver dams. When the water level became too high, the water overflowed onto the tailings area causing erosion and dispersion. Approximately 130 000 m^3 of tailings escaped into Davidson Creek. Elevated lead levels were detected in water samples of the sediment plume in the river (Meyer et al. 1991).

Notices were issued by the Ontario Ministry of the Environment to Matachewan Consolidated Mines, Ltd., Pamour Inc., and Goldteck Mines Ltd. as well as 2 Goldteck Mines Ltd. officers and a former Pamour Inc. officer (*Northern Daily News*, January 10, 1991). The Minister of the Environment ordered the cleanup of the tailings spill. The Ontario Ministry of Natural Resources (MNR) started the cleanup by first diverting the flow of Davidson Creek (*Northern Daily News*, February 6, 1991). The MNR completed the stabilization of the tailings by constructing a tailings containment wall at the base of the tailings-disposal site. A berm was constructed to divert Davidson Creek and to minimize further erosion of the tailings in the river bed. An

Environmental Appeals Board (EAB) ruled that Matachewan Consolidated Mines, Ltd. must stabilize the tailings around Davidson Creek (this work has been completed by MNR). The EAB stayed long-term studies of aquatic life pending an appeal by the company (*Northern Daily News*, April 18, 1991, p.1). Matachewan Consolidated Mines, Ltd. sought permission from its shareholders to sell some or all of its assets, the proceeds from which would be used to pay for legal costs for appealing the order to pay for the cleanup costs related to the tailings spill (*Northern Daily News*, September 12, 1991). Criminal charges were laid by the Ontario Ministry of Environment against Royal Oak Mines Inc., Goldteck Mines Ltd. and Matachewan Consolidated Mines, Ltd. and 2 of Matachewan Consolidated Mines, Ltd.'s officers. A hearing into the spill was to have started on January 13, 1992, in Kirkland Lake (*Northern Daily News*, October 19, 1991; *The Northern Miner*, October 21, 1991, p.13). The President of Matachewan Consolidated Mines, Ltd. reported that legal costs will likely drive the company into bankruptcy (*Northern Daily News*, October 22, 1991, p.1).

ONTARIO GEOLOGICAL SURVEY'S ACTIVITIES

Detailed information on the following projects can be found in the 1991 release of *Summary of Field Work and Other Activities* by the Ontario Geological Survey (OGS 1991b).

Precambrian Geology Section

S.L. Jackson continues a study of structure and stratigraphy in the Larder Lake area.

D. Kresz started a detailed-mapping project in the Matachewan area. Argyle and Baden townships were the first 2 of several townships to be mapped in the area.

M. Carter has started a compilation and province-wide study of mineralized and unmineralized alkalic metavolcanic rocks.

Northern Ontario Development Agreement

A joint federal-provincial agreement on mineral development was recently signed. Three major projects proposed are as follows:

1. A program of overburden drilling combined with till geochemistry and till stratigraphy in the Blake River Syncline area to the northeast of Kirkland Lake. The syncline is comprised of volcanic sequences that have the potential to host volcanogenic massive sulphide deposits. Much of the area was not surveyed by the overburden sampling that was conducted as part of the Kirkland Lake Initiatives Program (KLIP) and Black River–Matheson (BRiM) Program.
2. A Geographic Information System (GIS) data base for the Temagami area involving input from the Ontario Ministry of Natural Resources. The data base would eventually be expanded to include the Cobalt and Kirkland Lake areas.
3. A program of high-resolution, airborne-based magnetic- and electromagnetic-field surveys for the central section of the Blake River Syncline. The proposed area would include the National Topographic System (NTS) map areas 32 D/4 (N half), 32 D/5 (S half), 42 A/1 (N half) and 42 A/8 (S half). The existing data was collected in 1979 in analogue format, thus, rendering it unusable to current computer-processing methods.

RESEARCH BY OTHER AGENCIES

Universities

Detailed information on most of the following projects may be found in *Geoscience Research Grant Program, Summary of Research 1990–1991* (OGS 1991a) or in the Abstracts, Ontario Mines and Minerals Symposium, December 9–11, 1991 (OGS 1991c).

CARLETON UNIVERSITY

A. Donaldson and R. Rice continued research to refine the understanding of past sedimentary and structural geology environments, and the relationship of economic mineralization to sedimentary characteristics of metasedimentary rocks in the Wawa, Timmins and Kirkland Lake regions.

McMASTER UNIVERSITY

A.P. Dickin continued research using the $^{187}Os/^{188}Os$ isotopes technique as a tracer to study how magma-mixing processes may be related to the formation of platinum group elements (PGE) deposits.

UNIVERSITY OF OTTAWA

G. Leveque and A. Lalonde are studying the geochemistry and mineral chemistry of hypabyssal and intrusive felsics rocks in the Kirkland Lake–Larder Lake area.

A. Lalonde is studying the physical and chemical characteristics of biotite associated with ore-related hydrothermal veins at the Macassa Mine to determine if green pleochroism of the micas is an indicator of oxidizing conditions and gold mineralization.

UNIVERSITY OF QUEBEC—CHICOUTIMI

D. Bandyayera and W. Mueller with the help of Z. Arias are studying the sedimentology and volcanology of the Kirkland Lake Basin.

QUEEN'S UNIVERSITY

R. Harrap and H. Helmstaedt began mapping the structures in the margin and interior of the Round Lake Batholith in order to understand the history of the body and the surrounding volcanic rocks. They hope to use this knowledge to increase the understanding of the evolution of the southern Abitibi volcanic belt.

R.B. Hrabi and H. Helmstaedt continued mapping the distribution and orientation of structure in the Midlothian Lake–Peterlong Lake area in order to understand the structural geological history of the area as well as to evaluate the structural control and relative timing of gold mineralization.

W. Daniels is studying the rock-slope stability of the South Pit at the Adams Mines site.

UNIVERSITY OF TORONTO

D. Channer and E. Spooner began a study of the Kerr Mine gold-bearing vein system to test for exploration characteristics that might be applied in the search for large gold deposits.

A. Cruden is working with Lithoprobe data to determine the timing of the emplacement of syenite stocks with respect to regional deformation and to determine the kinematic evolution of the Larder Lake Break.

UNIVERSITY OF WESTERN ONTARIO

M. Collison, M. Clegg, A. Edgar and R. Sutcliffe began studying the mineralogy, petrology and geochemistry of alkaline metavolcanic rocks of the Timiskaming Group in the Kirkland Lake area to determine if there is a relationship between the alkaline volcanics and gold mineralization. They will also compare the Archean alkaline rocks to unmineralized, younger Phanerozoic alkaline suites.

PUBLISHED GEOLOGICAL RESEARCH

Figure 14.4 shows the areas covered by individual government reports and maps and research projects carried out in the Kirkland Lake Resident Geologist's District since 1984. References for each project are followed by the Kirkland Lake Resident Geologist's office file number.

REGIONAL GEOLOGIST'S ACTIVITIES

A detailed, multiyear study on the genesis of gold in the Matachewan–Kirkland Lake–Larder Lake area was completed in 1991. The report, entitled *The Sedimentary Phase that Inititated the Concentrating of Matachewan–Kirkland Lake–Larder Lake, Ontario, and Other Similar Gold Ores prior to Their Modifications by Metamorphism*, is available for public review at the Resident Geologist's office in Kirkland Lake. In addition to the report, the Regional Geologist has also conducted the following activities: guided and/or accompanied and reported on 20 geological surface and/or underground field trips for industry, university and government geologists; gave oral presentations on sedimentary gold protore at the Northeastern Ontario Regional Geosience Symposium in April, 1991, and at a field trip hosted by the Geological Association of Canada, Mineralogical Association of Canada and Society of Economic Geologists at Kirkland Lake in June, 1991; logged diamond-drill core for part or all of 15 drilling projects, most of which were financially supported by the Ontario Prospectors' Assistance Program; visited and reported on 23 mineral exploration properties, a few of which are included in this report; provided approximately 300 individual consultation services; and attended several meetings including those held by the Northern Prospectors, the Canadian Institute of Mining and Metallurgy, the Association of Professional Engineers, and the Geological Survey of Canada's Activities Forum.

The following section briefly details the geology of several mineral-exploration properties visited during 1991.

Atapa Block 4 Gold Occurrence, Catharine Township, Concession VI, Lots 11 & 12

At the Atapa Block 4 Gold Occurrence, 6 cross trenches dug to bedrock in 1990 by the claim holder expose an almost complete stratigraphic section over a 600 foot strike length. The main rock types exposed are intercalated upper Catharine Group tholeiitic basalt flows, interflow sedimentary rocks and lower Skead Group calc-alkalic tuffs overlain by Skead Group calc-alkalic flow breccias. A summary of the composite stratigraphic section from top (east) to base (west) is as follows:

1. Pale- to dark-buff-coloured, coarsely brecciated calc-alkalic basalt with differentially weathered fragments ranging in size up to 0.5 m along their maximum lengths. The breccia unit is cut by several calc-alkalic dikes.

2. Massive, homogeneous calc-alkalic tuff (or possibly flow) containing up to 35% white feldspar phenocrysts ranging in size from 1 to 3 mm long.

3. Calc-alkalic tuff consisting of thick, coarse-grained (a few pebble-sized fragments) to fine-grained beds trending at 310°. The fine-grained beds contain unabraded cubes of medium-grained, secondary pyrite and crushed pumice fragments. Tops face northeast, as defined by the fining upwards of the sequence and by ejectamenta bombs that depress and truncate sedimentary laminae.

4. Sandstone with scour channels filled with ripped-up siltstone beds and subangular to subrounded, calc-alkalic and smaller, greenish-black, chloritic pebbles of low to high sphericity.

5. Calc-alkalic basalt containing anastomosing zones of reddish-brown, fine-grained igneous material with 4 mm long white feldspar grains.

6. A tholeiitic basalt (greenstone) flow.

7. A calc-alkalic basalt flow.

8. A thin-bedded interflow sediment topped by scour-and-fill channels indicating that tops are to the northeast.

9. A tholeiitic basalt flow cut by calc-alkalic dikes.

10. A northeast-facing, graded-bedded interflow sandstone containing lithic fragments (broken beds of chert and greenstone).

11. Massive chloritic greenstone (i.e., tholeiitic basalt).

12. Interbedded calc-alkalic tuff and chert.

13. A pillowed greenstone (tholeiitic basalt flow).

This stratigraphic section is part of a continuous, structurally conformable volcanic cycle that was first recognized by R.H. Ridler (1970, p.36).

Lois Lake Gold Occurrence, Teck Township

The Lois Lake gold occurrence is located at the southern end of the lake it is named after and it is accessible via an all-terrain vehicle (ATV) trail from the Goldthorpe Road. Stripping has exposed for 45 m a 2 m wide shear zone that is filled with an auriferous quartz-carbonate stockwork hosted in basalt. Mafic pegmatitic zones in the basalt consist of up to 4 cm long amphibole phenocrysts in a matrix of white feldspar. Also present are 1 cm wide chloritic veins and epidote-calcite stringers.

Northwest of Lois Lake, accessible by an ATV trail from the Winnie Lake Road or an ATV trail north from Lois Lake, is a small area of bedrock exposed by stripping. The bedrock exposure consists of magnesium-rich tholeiitic basalt and maroon-coloured, conchoidally fractured cherty rocks that host iron sulphides in the basalt, particularly in the interstices between pillow-breccia fragments. Anastomosing, gold-bearing quartz-carbonate stringers contain disseminated cubes of medium-grained pyrite and also lenses of pyrite along fractures in the wall rock.

Bedrock exposure at a pit north of Lois Lake has been extended for 200 m by stripping. Here, pebbly sandstone and mudstone and iron-sulphide-rich stratafer (a stratafer is a low-grade banded iron formation) totalling 10 m in thickness are overlain and underlain by tholeiitic basalt.

Also present is a reddish-coloured syenite porphyry. Most of the sedimentary rocks are thin bedded, strike 190°, dip steeply west and apparently occupy the nose of a syncline that opens to the west. Many of the sedimentary units are broken and detached and form lithic fragments of resistant, conchoidally fractured, dark-grey feldspathic chert in a matrix of differentially weathered flow basalt. Thin edges of this matrix material are composed of pale-brown biotite, (possible incipient lamprophyre resulting from the hybridization of basalt and sediments). The tholeiitic pillowed-basalt flows indicate that tops face west. Iron-sulphide mineralization occurs between the pillows and between pillow breccia flow-top fragments.

Overlying the footwall tholeiitic basalt, the interflow sedimentary rocks consist of grey chert (less feldspathic than the one discussed in the previous paragraph) and mudstone. They contain less sulphide content and display no recognizable contamination by the hanging-wall basalt flows to depths of more than 5 m from their contacts.

Approximately 300 m along strike to the south, brownish chert containing iron sulphides and tholeiitic basalt cut by feldspar-porphyry dikes are exposed in cross trenches and in a pit on the west wall of a small canyon. The iron-sulphide-bearing sedimentary units appear to pinch and swell along a 0.5 km strike length as evidenced by their exposure at this location as well as in the main exposure of stripped outcrop 300 m to the north.

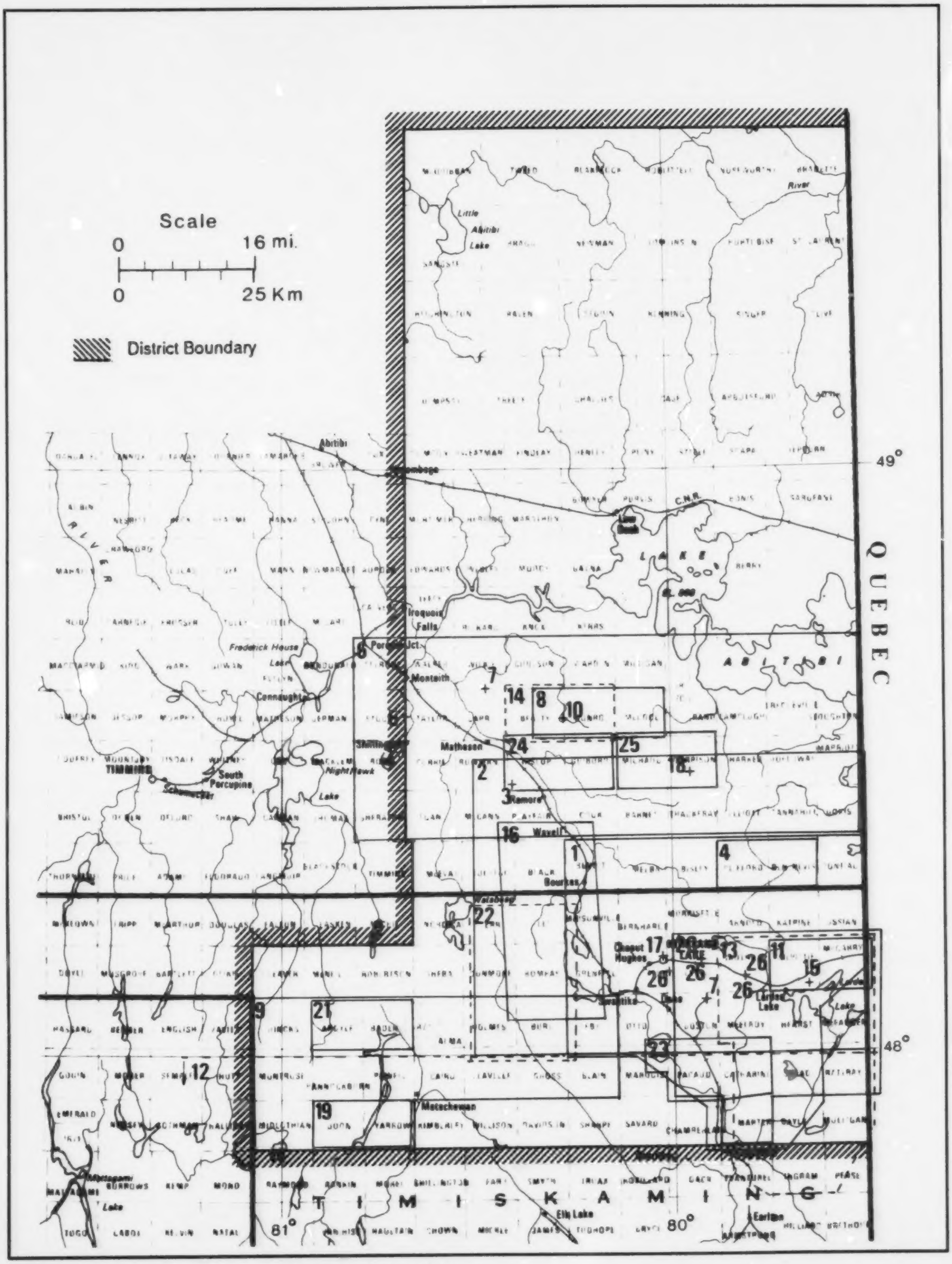
Ostrom (Canoro) Gold Prospect, Catharine Township

The Ostrom (Canoro) gold prospect consists primarily of an old shaft sunk in a gold-bearing quartz-carbonate vein in Concession III, Lot 6 north half, Catharine Township.

This shaft is a 150 m decline sunk in the 1920s down the 65°S dip of the No.12 vein which—as is also the case for the No.14 vein—contains visible gold (Bell 1929).

Approximately 350 m of drifting and crosscutting was done on the 150 m level, including a crosscut driven 80 m south of the No.14 vein and the drilling of several diamond-drill holes. The property was essentially idle between 1928 and 1990, when several areas of bedrock were stripped and a single diamond-drill hole was drilled by the present claim holder. In 1991, a total of 7 more diamond-drill holes were drilled, most oriented to intersect east-trending, pyritiferous (up to 5%) quartz veins that cut the strata at roughly right angles.

The southernmost stripping exposed the No.13 quartz-carbonate vein which trends 125° and, where observed, cuts vesicular pillowed calc-alkalic basalt. The vesicles are of medium size range, indicating either a moderate depth of water and/or moderate gas pressure during volcanism. Intercalated with the calc-alkalic basalt is a tholeiitic basalt (Catharine Group) which is rusty (carbonatized) and contains vesicles and amygdules rimming inside pillow selvages. The tholeiitic basalts are cut by cream-coloured, calc-alkalic dikes wherein the chilled margins are less than 2 cm wide; these dikes probably represent the feeders for the strata of the younger, overlying Skead Group.


Scale
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District Boundary
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LAKE
TIMISKAMING
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48°
81°
80°
Little Abitibi Lake
River
Abitibi
C.N.R.
Iroquois Falls
Frederick House Lake
Porquis Jct.
Monteith
Connaught
Matheson
Night Hawk Lake
TIMMINS
South Porcupine
Schumacher
Ramore
Wavell
Black
Bourkes
Kirkland Lake
Chaput Hughes
Swastika
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Figure 14.4. Location of published geological research since 1984.

Figure 14.4. Location of published geological research since 1984, Kirkland Lake Resident Geologist's District.

Map Number

1. Fortescue, J.A.C., Lourim, J., Gleeson, C.F., Jensen, L. and Baker, C. 1984. A synthesis and intepretation of basal till geochemical and mineralogical data obtained from the Kirkland Lake (KLIP) area (1979–1982); OGS, OFR 5506, 2 volumes, 630p. (KL Ref. #105506)

   McClenaghan, M.B. and Wyatt, P.H. 1990. Summary of overburden and bedrock trace element data from the Kirkland Lake Initiatives Program (KLIP) reconnaissance till sampling program; OGS, OFR 5737, 470p. (KL Ref. #105737)

2. Baker, C.L. 1985. Quaternary geology of the Kirkland Lake area, districts of Cochrane and Timiskaming; OGS, OFR 5553, 144p. (KL Ref. #105553)
3. Schwarcz, H.P. and Rees, C.E. 1986. OGRGP Grant No.202, Sulphur studies of Archean gold deposits; OGS, OFR 5622, 13p. (KL Ref. #105622)
4. Grunsky, E.C. 1986. Recognition of alteration and compositional variation patterns in Volcanic rocks using statistical analysis of lithogeochemical data, Ben Nevis Township area, District of Cochrane, Ontario; OGS, OFR 5628, 187p. (KL Ref. #105628)
5. Redman, J.D., Zhao, S.K. and Strangway, D.W. 1987. OGRGP Grant No.260, Magnetotelluric mapping of the Destor–Porcupine Fault; OGS, OFR 5674, 37p. (KL Ref. #105674)
6. Bath, A.C. 1990. Mineral occurrences, deposits, and mines of the Black River–Matheson area; OGS, OFR 5735, 3 volumes, 1883p. (KL Ref. #105735)

   Bloom, L.B. 1987. Analytical methods, quality control data and previously unpublished geochemical results: Reconnaissance till sampling program, Matheson area, Cochrane; OGS, Open File Report 5653, 152p.

   McClenaghan, M.B. 1990. Summary of results from the Black River–Matheson (BRIM) reconnaissance surface till sampling program; OGS, OFR 5749, 197p. (KL Ref. #105749)

   Jones, R.M. 1985. Parameters for distinguishing between two tills for exploration in the Matheson area and Utex gold proposal for exploration, Matheson, Ontario; unpublished BSc thesis, University of Toronto, Toronto, Ontario, 64p. (KL Ref. #120030)

   MNDM Geological Data Inventory Folios; OGS GDIF 264–272, 342–344, 349–352, 356–358, 360–361, 368–370, 380–383, 399–404.

   OGS 1984. Airborne electromagnetic and total intensity magnetic survey; OGS Maps 80572–80611, Geophysical/Geochemical Series, scale 1:20 000.

   OGS Backhoe and surface till samples; OGS Maps 80793–80796, 81136–81143, Geophysical/Geochemical Series.

   OGS Bedrock geology maps; OGS Preliminary Maps p.2848, P.2986, P.3114 and P.3136.

   OGS Backhoe till and sonic drill hole sample gold grain distribution maps; OGS, Preliminary Maps P.2736, P.2958, P.2983, P.3097 and P.3130.

7. Gerow, M.C., Sherlock, E.J. and Bellinger, J.A. 1991. Soapstone in Ontario; OGS, OFR 5764, 208p. (KL Ref. #105764)
8. Johnstone, R.M. 1991. The geology of the northwestern Black River–Matheson area, District of Cochrane; OGS, OFR 5785, 288p. (KL Ref. #105785)

   Johnstone, R.M. 1991. Geology of Beatty Township, District of Cochrane; OGS, Open File Map 158, scale 1:15 840.

   Johnstone, R.M. 1991. Geology of Munro Township, District of Cochrane; OGS Open File Map 159, scale, 1:15 840.

   Johnstone, R.M. 1991. Geology of McCool Township, District of Cochrane; OGS, Open File Map 160, scale 1:15 840.

9. Powell, W.G. 1991. OGRGP Grant No.329, The distribution, structural history and relationship to regional metamorphism of high-strain zones forming the Larder Lake–Cadillac Deformation Zone, Matachewan area, Abitibi Belt; OGS, OFR 5789, 150p. (KL Ref. #105789)
10. Allen, R.L. 1986. Petrology and chemistry of a komatiite sill and Fe-Ni-Cu sulfide mineralization, Munro and Beatty townships, Ontario; unpublished MSc thesis, Queen's University, Kingston, Ontario, 108p. (KL Ref. #120002)

Map Number

   Canil, D. 1985. The petrology and geochemistry of komatiites and tholeiites from the Deadman Hill area, Munro Township, Ontario; An unpublished BSc thesis, University of Windsor, Windsor, Ontario, 76p. (KL Ref. #120008)

   Chivers, K. 1984. A study of a layered ultramafic sill, Beatty Township, Ontario; An unpublished BSc thesis, Queen's University, Kingston, Ontario, 40p. (KL Ref. #120010)

11. Hamilton, J.V. 1986. The structural and stratigraphic setting of gold mineralization in the vicinity of Larder Lake, south-central Abitibi greenstone belt, northeastern Ont; unpublished MSc thesis, Queen's University, Kingston, Ontario, 156p. (KL Ref. #120024)
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The No.12 vein at the Ostrom shaft strikes northeast, dips 65°SE and cuts several iron-rich tholeiitic-basalt flows which top toward the northeast. The vein system consists of quartz with central rusty seams of carbonate. Magnetite is present as disseminations throughout the basalt and in veins that pinch and swell. The character of the veins alternates along strike between being magnetite rich and dolomite rich. A pit 60 m northeast of the Ostrom shaft opens up malachite-stained fractures in basalt that are cut by a magnetite-chalcopyrite vein.

A porphyry zone cuts the pillowed top above the massive base of a tholeiitic flow. This porphyry is mainly a massive calc-alkalic intrusive, the weathered surface of which has rusty pits less than 1 cm deep where carbonate has been leached out. Cutting the calc-alkalic intrusive are numerous anastomosing quartz-ladder veins striking perpendicular to the east-southeast trend of the intrusive's contact.

The Central Zone consists of grey "cherty" quartz veins within carbonate-rich basaltic wallrock containing flakes of fuchsite (mariposite). The fuchsite (mariposite) appears to be a compositional variation of the chlorite in the calc-alkalic dikes that intrude into the tholeiitic-basalt country rock.

None of the Ostrom shaft area's vein systems are composed of coarsely crystalline, white bull quartz; all contain pyrite and some contain chalcopyrite and gold.

B. Vallier–L. Prevec–A. Carreau Gold Occurrence, Grenfell Township

Airborne-survey-compiled geophysical map P.2262a published by the Ontario Geological Survey (OGS 1979) indicates magnetic anomalies that proceed eastward from Grenfell Township into adjacent Teck Township; these anomalies have since been subjected to follow-up trenching . In 1990, the claim holders completed very low frequency electromagnetic (VLF-EM) and magnetic ground surveys using funding provided through the Ontario Prospectors Assistance Program (OPAP). In 1991, they drilled a diamond-drill hole northward through turbidites (nonmagnetic, interbanded buff-coloured sandstone and dark-grey mudstone) that contain azurite and malachite in fracture-filling calcite. The turbidite's mineralogy is comprised mainly of feldspar and quartz. Malachite also occurs on graphitic slips in sedimentary rocks to the south of the drill setup. Low-grade copper and gold values were obtained from assays of the drill core. More drilling is planned to test northwards to the top of these sedimentary rocks and southwards to test any underlying sedimentary horizons that may represent more favourable stratigraphy for sedimentary-rock-hosted gold ore.

Roughly along strike and 400 m southwest of the drill setup along an ATV trail that follows a beaver dam across Kapakita Creek, the prospectors detected coincident VLF-EM and magnetic anomalies. A nearby outcrop of feldspathic chert contains minor disseminated pyrite and a few pyrite-bearing veinlets. Sulphide-facies iron formation, composed primarily of partially banded and partially crosscutting veins of pyrite and pyrrhotite, is found in an old pit located north of the ATV trail. Plans are to explore for copper and zinc mineralization along the projected extensions of this iron formation.

A. Allsopp Gold Occurrence, Eby Township, Concession V, Lot 1

Using OPAP funding this past summer, 3 north-trending cross trenches were excavated to bedrock by prospector A. Allsopp on his property located south of Kenogami. The property is accessed via an ATV trail for a distance of approximately 1 km to the east from just south of the intersection of Highway 11 and an electric-power transmission line. The main rock types present are Skead Group, calc-alkalic, quartz-feldspar porphyry intrusives and related breccia that may be pyroclastic or flow material; Larder Lake Group tholeiitic-basalt tuffs and flows; and detrital to chemical, interflow sedimentary rocks. The stratigraphic section exposed north from 105 m north of the southern end of the longest (middle) trench is briefly described below:

Middle Cross Trench Stratigraphy
(proceeding north from point indicated above;
measurements given as absolute values)

Absolute Length (m)	Description
5	interflow magnetite-pyrite sedimentary rocks
45	greenish-black basalt containing disseminated pyrite in places and inclusions of feldspar-silica substrate seemingly ripped up by the flow
1	red hematite-stained (seafloor alteration or syenitization by an intrusive) greenstone flow breccia
4	pillow basalt
8	massive (reddish-weathered surfaces) flow containing angular mafic inclusions (resembles trachybasalt)
9	greenstone
5	interbedded siliceous and calcareous interflow sedimentary rocks, some of which contain significant amounts of disseminated pyrite (and possibly gold)
8	more purely carbonate composition sedimentary rock
2	sericite-quartz-disseminated pyrite-bearing sedimentary rock

12	carbonate-rich, largely chemical (lesser detrital) sedimentary rock containing disseminated pyrite
9	(at picket 6+50 N); carbonate rock, which is irregularly pitted so as to resemble leached Paleozoic limestone, interbedded with feldspathic chert in which disseminated fine- and medium-grained pyrite occurs
27	gap where ponded groundwater occurs (low ground)
2	graphite schist, i.e., carbonaceous slate that either extends or is repeated under the pond to the south, as indicated by parapet muck
18	greenstone with a few zones of disseminated pyrite and with a felty texture that has been called "Keewatin diabase" in some old reports

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15. Cobalt Resident Geologist's District—1991

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INTRODUCTION

The cessation of silver and iron mining activities in 1990 marked the end of an era in the Cobalt Resident Geologist's area. Little likelihood of improvement in the price of silver is expected in the foreseeable future. Reserves exist but they are too small or too low-grade to exploit by conventional narrow-vein mining methods. The possibility that Cobalt's silver mines will never reopen must be considered. Similarly, future production of iron ore at the Sherman mine in Temagami is equally remote. The basic structure of metals prices would have to change dramatically before these projections could be revised.

For most of 1991, exploration activities consisted of Ontario Prospectors Assistance Program (OPAP) and Ontario Mineral Incentive Program (OMIP) supported projects. Twenty-five OPAP grants, totalling $236 548 and 5 OMIP grants worth $387 206 were awarded in the Cobalt Resident Geologist's district. Only during the latter part of the year was an increase in privately funded activities noted. A late upsurge in exploration activities is currently taking place in the Shining Tree area and is due directly to the discovery by Fort Knox Gold Resources Inc. of significant nickel and copper mineralization in Fawcett Township. This land was included in the Temagami Land Caution prior to being reopened to staking in April, 1990.

Considerable interest has been shown in the base metal potential of the Archean metavolcanics in and around the Cobalt silver camp. One result of the renewed interest was the completion of a deep drilling project in Coleman Township by Legacy Explorations Inc. and Agnico-Eagle Mines Ltd. In addition, over 480 units were staked in the Cobalt area during the second half of 1991 by companies planning to explore for base metals. The dramatic rise in the price of cobalt during the latter part of 1991 has also led to renewed interest in the Cobalt, Silver Center, Elk Lake and Gowganda silver-cobalt mining areas. If labour unrest persists in Zaire for any length of time, existing reserves of the strategic metal in Canada may become economically exploitable.

In 1991 the long standing dispute between the Teme Augama Anishnabai, also known as the Bear Island Band, and the Province of Ontario was settled in the courts. This dispute led initially to the establishment in 1973 of the Temagami Land Caution and the subsequent implementation of a Withdrawal From Staking Order in 1978 that has frozen a 10 000 km^2 area comprising all, or part of, 110 townships.

Prior to the release of the Supreme Court of Canada's decision, the two sides entered into negotiations with the resolve to establish a new treaty of co-existence suitable to the needs and desires of both parties. Some of the early results of the ongoing negotiations suggest that cautious optimism prevails on the part of the mining industry in Ontario.

In April, 1990, over 1100 km^2 of land peripheral to, but not included in, the Temagami Land Caution was reopened for staking by the Government of Ontario. Following the Supreme Court of Canada's decision late in 1991, the Bear Island Band arbitrarily announced the lifting of the Land Caution on four townships: Strathy, Cassells and Best townships in the Temagami area and James Township near Elk Lake. Interest in the four townships by the exploration industry has been intense, thus the ministry has announced plans for the reopening to staking of these lands effective January 7, 1992.

MINING ACTIVITY

Dymond Clay Products Limited, Bucke and Breault Quarries (T. Overton)

Dymond Clay Products Limited (DCPL) operates two limestone quarries in Bucke and Dymond townships near New Liskeard. In addition to limestone production, DCPL recently commissioned a vertical continuous-feed lime kiln at their Bucke quarry site in Haileybury. To provide suitable high calcium oxide feed for the kiln, the Breault Quarry, located in northeastern Dymond Township, was brought into production in 1990. Dymond Clay Products Limited produces a variety of products including Gabian Stone, granular road building material, crushed metallurgical limestone (flux), quick lime and agricultural lime. The company is currently evaluating the suitability and market potential of a lime-magnesia (CaO-MgO) blend that has applications in the treatment of flue gases. Minor amounts of MgO in lime also reduces scale build-up in lime delivery pipes, a common problem in most neutralizing plants.

To the end of October, 1991, approximately 47 600 tonnes of limestone product had been sold and an additional 5000 tonnes were stockpiled on the two properties. Lime sales totalled 3100 tonnes which accounted for approximately 6.5% of total sales. Lime is currently in demand as a pH control in gold milling operations and as a neutralizing agent in acid-generating mine wastes. Dymond Clay Products Limited are strategically located as they are 300 km closer to potential markets in Quebec and Ontario than the next nearest source of lime.

A series of refractory brick failures in the newly commissioned lime kiln severely limited lime production in 1991. Dymond Clay Products Limited brought in a number of refractory experts in an effort to solve the problem and they hope to have the operation running on a continuous basis early in 1992.

A detailed description of the geology of the Breault Quarry is included below under "Property Examinations".

McLaren's Bay Mica Stone Quarries (G. Boughner)

A total production of 40 tonnes was reported by McLaren's Bay Mica Stone Company to the Ministry of Natural Resources in North Bay. The quarry is located on the north shore of Reynold's Lake, McAuslan Township. Quarrying activity has remained at a level similar to last year according to Mr. G. Boughner. Activity in the building stone market is not expected to change much in the next year. The company is currently reviewing alternative markets.

The operation contains a number of pits from which mineralogically distinct micaceous quartzites and gneisses are quarried. The different coloured stones are crushed to sizes ranging from 5 cm to -50 mesh. Coarse material is then used as ornamental landscaping gravel and finer material is used as a metallic paint additive. The stone is marketed in Toronto, Montreal and the United States.

Thorne Brilliant Stone Quarry (P. Pharand)

Thorne Brilliant Stone Quarry reports a total of approximately 40 to 50 tons of patio stone sold this year from their pit in the northern half of Poitras Township. The owner, Mr. P. Pharand, claimed to have an additional 130 tons of prepared stone on pallets ready for sale and a further 200 tons broken. His primary market remains in South Temiskaming but he has also had requests from southern Ontario distributors to send samples of his stone for marketing. The owner also mentioned a possible 3 year contract for a substantial amount of rock to be used as a church facing in southern Quebec.

The property is quite extensive and to date, only a small portion has been actively quarried. The site is predominately underlain by quartz-muscovite gneiss. Minor quantities of biotite gneiss are also present and quarried. One road has been extended this year to evaluate the potential of a new rock type found on the property. Chris Marmont, Contract Geologist, Dorset Resident Geologist's Office, has identified this lithology as a purple, micaceous, quartzo-feldspathic gneiss.

ADVANCED EXPLORATION AND DEVELOPMENT

No advanced exploration or development activities were reported in 1991 in the Cobalt Resident Geologist's area.

EXPLORATION ACTIVITY

Underground exploration activities ceased entirely in 1991. Surface exploration activities increased relative to the year prior. A total of 39 individuals or companies carried out exploration activities (excluding claim staking) in the Cobalt Resident Geologist's District. Visitors to the Cobalt Resident Geologist's Office in 1991 were up 35%, to 995.

No underground diamond drilling was carried out during the year while 13 individuals or companies conducted surface diamond drilling programs. Surface diamond drilling this year amounted to 5932 m, which is an increase of 293% from the previous year.

A more complete summary of exploration activities in the Cobalt Resident Geologist's District in 1991 is provided in the following sections (*see* Tables 15.1, 15.2 and Figures 15.1, 15.2, 15.3, 15.4 and 15.5). Relevant Ontario Geological Survey publications are listed in Table 15.3.

Cobalt Area

G. Chitaroni completed 1 diamond drill hole totalling 221.6 m in Coleman Township, west of Green Lake. The hole tested a

Table 15.1 Summary of claims recorded and cancelled during the year.

Month	Staked		Cancelled
	Units	Claims	Claims
December	—	78	2
January	—	71	4
February	—	34	91
March	—	24	1
April	—	35	7
May	—	11	0
June	2	2	12
July	7	7	0
August	56	10	0
September	217	33	3
October	61	12	0
November	161	22	0
Total =	504	339*	120

* NB: number of claims staked represents both single and blocked staked units

magnetometer-HLEM anomaly which had previously been defined by St. Joseph Explorations Ltd. The hole failed to explain the EM anomaly. A 24.4 m thick gabbroic-lamprophyre dike containing minor sulphides was intersected at approximately 179.8 m downhole. No appreciable Ni, Cu or Cr values were returned. Work was carried out using an OPAP grant. Late in 1991, Mr. Chitaroni successfully optioned this and several other claim groups to a major mining company (G. Chitaroni, personal communication, 1991).

Ground reconnaissance studies of the base metal mineralization potential of the Cobalt Camp were carried out by Falconbridge Exploration Ltd. This resulted in the staking of over 480 claim units in the Cobalt area (J. Ceccetto, Falconbridge Exploration Co. Ltd., personal communication, 1991).

J. Gore continued exploration of a claim group located in South Lorrain Township in the historic Silver Centre area. During the period of July 29 to August 1, 1991, a 70.1 m diamond drill hole was completed using OPAP funds. Drilling was targeted on a north-northeast trending structure where a shaft had been sunk in 1929 by The Mining Corporation of Canada Limited. Minor development was done from this shaft. Mention of a pod of cobalt and the potential for similar mineralization on strike within this structure was the basis of drill targeting. No significant cobalt or silver values were returned by the current efforts (J.Gore, prospector, personal communication, 1991).

Legacy Explorations Limited completed a deep diamond drilling program on the O'Brien-Violet property, located at the north end of the town of Cobalt in Coleman Township. Funding for this work was through an OMIP grant. An Agnico-Eagle Mines geologist supervised the project. The program was designed to test for base metal mineralization. Drilling targeted a sequence of pillowed and massive mafic volcanic rocks and minor intercalated interflow sedimentary rocks, as well as the O'Brien and Cobalt Lake fault structures. Two diamond drill holes totalling 2624 m were completed. The first drill hole was completed to a length of 1097.3 m, but was stopped after it had entered into an extensive sequence of bedded interflow sediments. This horizon is believed to mark the northern limit of any major silver mineralization. No downhole geophysical surveys were conducted as planned, as two bands of graphitic mineralization were intersected. The second diamond drill hole, which reached a depth of 1526.4 m, remained in the predominately mafic volcanic sequence throughout it's length. As in the first hole, an approximately 300 m thick zone of pyrrhotitic nodules was intersected at a vertical depth of 120 m. Downhole geophysical surveying was completed in October, the results of which are currently under review (B. Thornilly, Agnico-Eagle Mines Ltd., personal communication, 1991).

Englehart Area

G.C. Dunn and E. Korba carried out OPAP funded exploration activities on two properties located in Tudhope and Bryce townships.

The property in Tudhope Township is located west and south of Honeymoon Lake, adjacent to ground currently withdrawn from staking due to the Temagami Land Caution. The northern claims of this property are currently optioned to Pelangio Larder Mines Ltd. Soil sampling and a ground VLF-EM survey were completed by the owners on the southern 6 claims, underlain by Skead Group pyroclastic rocks. A number of northeast- and northwest-trending conductors were outlined by the electromagnetic survey. Three areas of anomalous (greater than 60 ppb Au) gold values were defined by the soil survey, which included an auriferous shear zone located on claim L.990957 (Lot 1, Concession III, Tudhope Township). This shear zone reportedly strikes 070°, is carbonatized and mineralized with chalcopyrite hosted in quartz veins. The structure has been traced for a length of 305 m. Values of 0.07% Cu and 6.65 g/t Au were reported. A ground magnetometer survey and detailed work in the vicinity of the VLF-EM anomalies is planned for December, 1991.

Prospecting by Dunn and Korba on a group of nine claims in Bryce Township, southeast of Pike Lake, revealed two areas of sulphide mineralization. In the vicinity of the Skead Group metavolcanics and Gowganda sediments contact, a grab sample from a northeast-trending carbonatized shear zone containing fuchsite and massive pyrite returned an assay value of 1.71 g/t Au (SW ¼ Lot 9, Concession II, Bryce Township). A zone of quartz stockwork, located in an inlier of felsic metavolcanic tuffs (NE ¼ Lot 9, Concession I, Bryce Township) returned a value of 11.21 g/t Au from a grab sample (G.C. Dunn, geologist, personal communication, 1991).

J. Ewanchuck, F. Swanson and J. Morris continued an investigation of claims located in Tudhope and Bryce townships, using OPAP funding. Approximately 20 km of line cutting and geophysical surveying (magnetometer and VLF-EM) were completed, as well as trenching and sampling. Three AQ-sized diamond drill holes, totalling approximately 192 m were completed on an area immediately south of the Taylor Vein. The drilling tested horizons delineated last year, where sampling from two surface test pits had previously returned values of 1.41 g/t and 3.40 g/t Au (J.Ewanchuck, Prospector, personal communication, 1991).

G.J. Gereghty completed exploration work on claims held in Pense Township using OPAP funding. Mr. Gereghty had planned to diamond drill this year but instead completed approximately 7 km of gravity and VLF-EM surveys. The electromagnetic survey employed a modified McPhar unit using an on site transmitter. The 1991 program was designed to screen previously defined VLF-EM conductors and magnetic trends for base metal sulphide mineralization. Interpretation of the results was in progress at the time of writing (G. Gereghty, prospector, personal communication, 1991).

Exploration activities by Gold Fields Canadian Mining Limited were completed in the vicinity of Honeymoon Lake, Tudhope Township. Geological mapping was completed during 1990. Two cut grids were established in January in Lot 1, Concession IV, Tudhope Township and a combined magne-

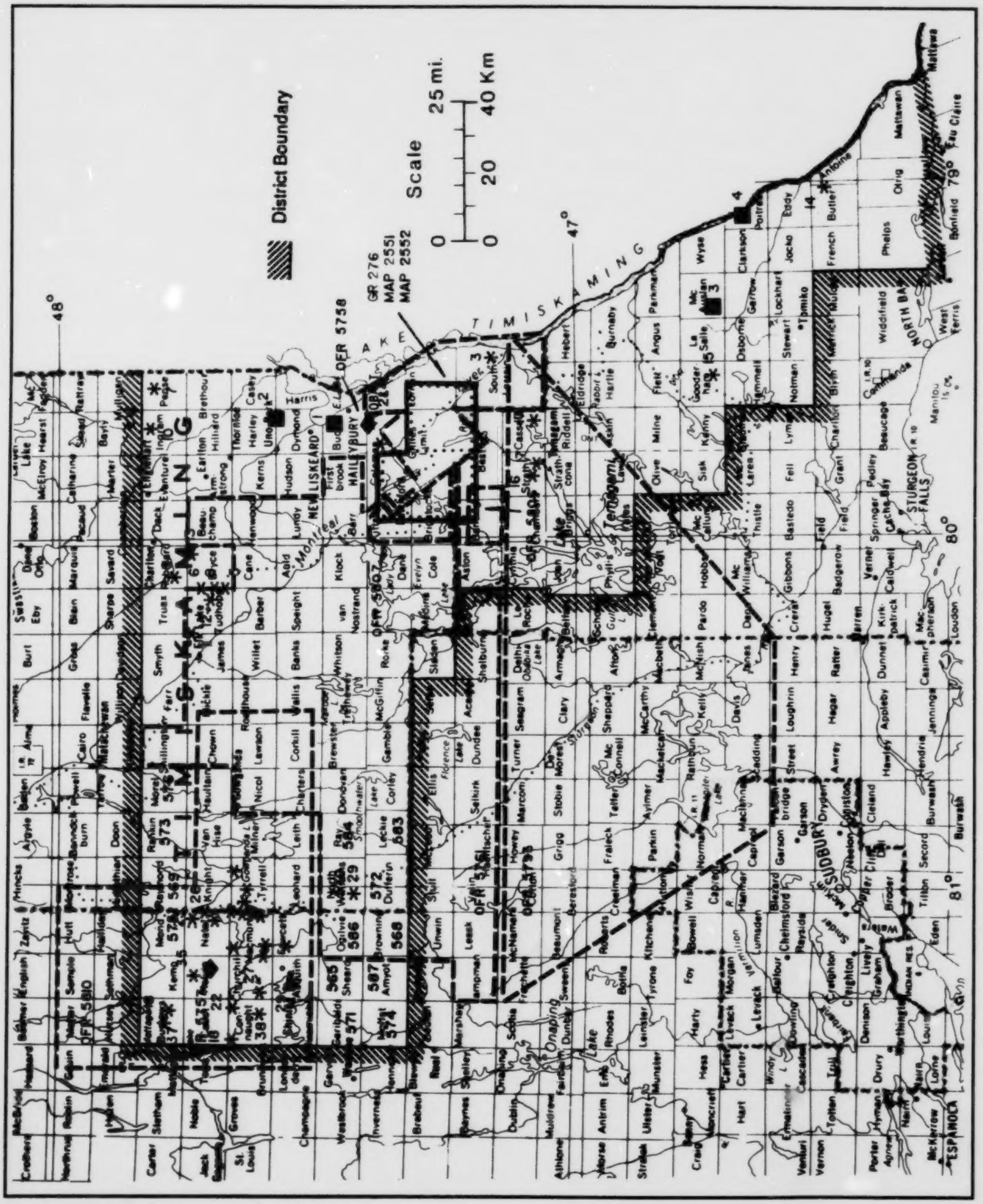
District Boundary
Scale
0 20 25 mi.
0 20 40 Km
48°
47°
79°
80°
81°
LAKE TIMISKAMING
GR 276
MAP 2551
MAP 2552
OFR 5758
NEW LISKEARD
HAILEYBURY
NORTH BAY
STURGEON FALLS
SUDBURY
Mattawa
ESPANOLA

Figure 15.1 Cobalt Resident Geologist's District.

EXPLANATION

Cobalt Resident Geologist's District

■ Producing Mines, 1991

1. Bucke Quarry (Cymond Clay Products Ltd.)	limestone
2. Breault Quarry (Dymond Clay Products Ltd.)	limestone
3. McLaren's Bay Mica Stone Quarries (G. Boughner)	stone
4. Thorne Brilliant Stone Quarry (P. Pharand)	stone

* Exploration Activity in 1991

570 GDIF Published in 1991

—◆— Geological Report (GR) issued by the Ontario Geological Survey in 1991.

.... Coloured Map issued by the Ontario Geological Survey in 1991.

------ Open File Report (OFR) issued by the Ontario Geological Survey in 1991.

———— Areas withdrawn from staking through Bear Island Indian Land Caution

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tometer and VLF-EM survey, as well as additional geological mapping, was completed.

The northern grid was established on a single claim north of Honeymoon Lake. The geophysical surveys outlined a 060° to 070° trending, southeast dipping feature which possibly correlates to the Palmer-Vaughan-Estival Break. A second, later, northwest-trending fault was also interpreted from the data. Both inferred structures are drift covered. The remainder of the claim is underlain by massive and pillowed metavolcanic flows of the Catharine Group.

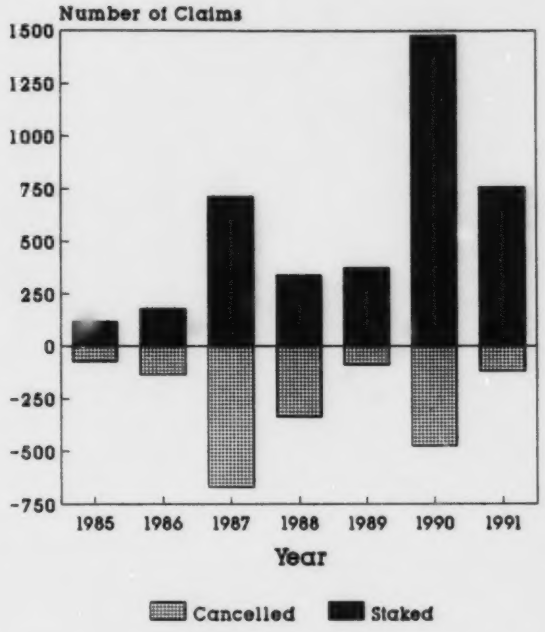
The second grid covered 4 claims on and immediately west of Honeymoon Lake. The grid is underlain by intermediate and felsic pyroclastic rocks of the Skead Group and minor acid intrusives. The geophysical surveys failed to reveal any significant anomalies. No further work is planned on the grids and claims have been returned to their previous owners (W. Waychison, Goldfields Canadian Mining Ltd., personal communication, 1991; assessment files, Cobalt).

Through OPAP funding, the partnership of L. Gondor and G. Atkins completed 48 line-kilometres of magnetometer and VLF-EM surveys on claims held in Robillard and Bryce townships. Several conductive anomalies were identified. Rock sampling of previously sampled outcrops failed to duplicate earlier assays of 0.10 and 0.11 ounces Au per ton. A portion of the property was optioned to Kingswood Explorations (1985) Limited for a work commitment of $50 000 for exploration and drilling in order to earn a 51% interest in the property. Detailed geological mapping and a confirmation induced polarization (IP) survey to redefine the anomaly were completed. Four diamond-drill holes totalling 1636 feet were completed to evaluate the IP anomaly. Sulphides, predominantly pyrite, were reported in the drill core. No decision on further work will be made until a thorough examination of the final geology and geophysical reports is complete (L. Gondor, Prospector, personal communication, 1991).

A galena showing in Ingram Township was explored by F. Marshall using OPAP grant funds. One 61.3 m diamond-drill hole tested a mineralized structure in Nipissing diabase. Several narrow galena and minor chalcopyrite-mineralized quartz veins were intersected, the largest vein being approximately 30 cm wide. The best assay results came from a sample located at 51.10 to 51.41 m downhole in a quartz bearing structure hosting a 1.9 cm massive chalcopyrite seam. The returned assay values for this sample were 0.012 ounces Au per ton, 1.46 ounces Ag per ton, 7.72% Cu, 3.53% Pb and 0.75% Zn across 0.30 m. A description of the Marshall property is included below under "Property Examinations" (F. Marshall, Prospector, personal communication, 1991).

Table 15.2. Exploration activity during the year.

Number	Individual or Company	Activity
1.	G. Chitaroni	Diamond drilling (OPAP), Coleman Twp.
2.	Falconbridge Expl.Ltd.	Reconnaissance geology, Cobalt area.
3.	J. Gore	Diamond drilling (OPAP), South Lorrain Twp.
4.	Legacy Expl. Ltd.	Diamond drilling (OMIP), Coleman Twp.
5.	Dunn and Korba	Soil sampling, VLF-EM, prospecting (OPAP), Tudhope and Bryce Twp's.
6.	Ewanchuck, Swanson and Morris	Line cutting, magnetometer, VLF-EM, diamond drilling (OPAP), Tudhope and Bryce Twp's.
7.	G. Gereghty	VLF-EM (OPAP), Pense Twp.
8.	Gold Fields Canadian Mining Ltd.	Geology, magnetometer, VLF-EM, Tudhope Twp.
9.	Gondor and Atkins/ Kingswood Expl. (1985) Ltd.	Magnetometer, VLF-EM, IP, geology, diamond drilling (OMIP), Robillard and Bryce Twp's.
10.	F. Marshall	Diamond drilling (OPAP), Ingram Twp.
11.	Obradovich and Crighton	Airborne magnetometer and VLF (OPAP), Tudhope and James Twp's.
12.	Orofino Resources Ltd.	Magnetometer, PEM, IP, Bryce Twp.
13.	858277 Ontario Inc.	Trenching, Bryce Twp.
14.	Kyanite Mining Corp.	Environmental assessment, Butler and Antoine Twp's.
15.	Aur Resources Inc.	Magnetometer, Gooderham and Eldridge Twp's.
16.	Gwen Resources Ltd.	Line cutting, magnetometer, VLF-EM, StrathyTwp.
17.	W. Manderstrom	Diamond drilling (OPAP), Cassels and Strathy Twp's.
18.	Asarco Expl. of Canada Ltd.	Line cutting, HLEM, magnetometer, diamond drilling, Burrows and Connaught Twp's.
19.	BHP-Utah Mines Ltd.	Airborne survey, geology, geochemistry, IP, VLF-EM, magnetometer, Tyrrell and MacMurchy Twp's.
20.	M. Caron	Line cutting, prospecting, magnetometer,VLF-EM (OPAP), MacMurchy Twp.
21.	Clark, Clark and Perkins	? (OPAP), Natal Twp.
22.	Copper Quest Inc.	Line cutting, VLF-EM, Connaught, MacMurchy and Asquith Twp's
23.	A. Decker	Trenching, prospecting, Natal and Knight Twp's
24.	Extender Minerals Ltd.	Trenching, sampling, diamond drilling North Williams Twp.
25.	Fort Knox Resources Inc.	EM, reconnaissance, diamond drilling, (OMIP) Fawcett Twp.
26.	Jones and Filo	Prospecting, VLF-EM, re-logging core (OPAP), Knight and Natal Twp's.
27.	G. Kent	Prospecting, claim staking (OPAP), Kelvin and Churchill Twp's.
28.	La Carte and MacCallum	Stripping, sampling, diamond drilling, Tyrrell Twp.
29.	J. Ladouceur	Prospecting, diamond drilling (OPAP), Asquith Twp.
30.	Londry and Mullen	Magnetometer, MacMurchy and Tyrrell Twp's.
31.	Obradovich, Crighton and Egg	Airborne magnetometer and VLF (OPAP) MacMurchy Twp.
32.	S. Ryan	Line cutting, magnetometer, VLF-EM, prospecting, geology (OPAP) MacMurchy Twp.
33.	N. Saville	Prospecting, trenching (OPAP), Asquith Twp.
34.	Skead Holdings Ltd.	Magnetometer, VLF-EM, geology, MacMurchy and Tyrrell Twp's.
35.	J. Tindale	EM, VLF-EM (OPAP), Kelvin Twp.
36.	Tindale, Annett and Ferguson	Line cutting, geology, magnetometer, VLF-EM, (OMIP), MacMurchy Twp.
37.	Tittley, Salo and Salo	Line cutting, geology, magnetometer (OPAP), Burrows Twp.
38.	Trinity Explorations	Airborne magnetometer and EM, Connaught Twp.
39.	Tyranex Gold Inc.	Diamond drilling (OMIP), Tyrrell and Knight Twp's.



*1991 as 16 Ha. claim units

Figure 15.2. Claim staking activity in the Cobalt Resident Geologist's District.

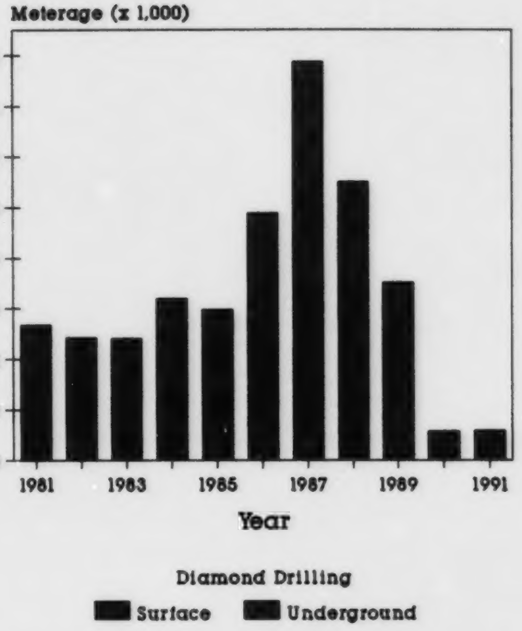


Figure 15.3. Exploration diamond drilling in the Cobalt Resident Geologist's District.

A property currently owned by T. Obradovich and R. Crighton consists of 4 contiguous claim units, 2 in northwest Tudhope Township and 2 in northeast James Township. This property includes a portion of the past-producing Ethel Copper Mine property. Mineralization in the vein zone at the former mine site includes chalcopyrite, bornite, and specularite in a carbonate matrix within Nipissing diabase. The average grade of the ore was reported to be 3.15% copper over 6.3 feet. An assay of 10.4% copper over 2.8 feet was documented in a drill log from previous work but other reported drill assays showed a wide range of values (MacKean 1968).

The claims are underlain by Nipissing diabase overlying sedimentary rocks of the Gowganda Formation. From diamond- drill records, the thickest section of diabase intersected was 140 feet. The veins within the diabase were apparently the richest and only of marginal grade in the underlying sediments (MacKean 1968).

This year the partnership, funded by OPAP, completed a total of 9 line-miles of airborne magnetic and VLF-EM surveys over the property. Three fault zones were defined by the magnetic survey and 2 EM anomalies, one of which correlates with one of the inferred faults. The partners' future plans include geological mapping and combined detailed ground magnetic and horizontal-loop EM surveys.

Further work was completed this fall, but no information was available at the time of writing.

Orofino Resources Limited completed geophysical surveys in Bryce Township on claims optioned from J. Morris, located north and northwest of Heather Lake. Ground magnetics was completed as well as nine lines of combined Crone pulse EM and induced polarization surveys on selected sections of the property (assessment files, Cobalt).

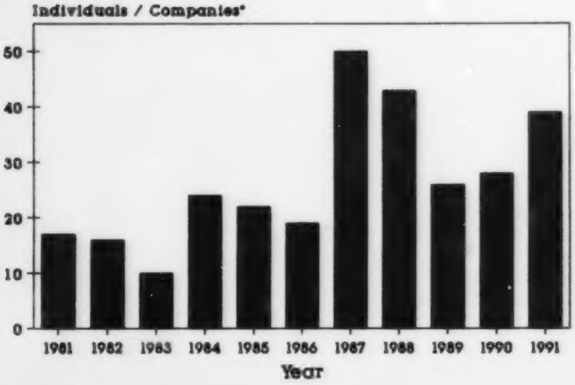
Gowganda–Elk Lake Area

No significant exploration activities were noted in the Gowganda–Elk Lake area during the year by the Cobalt Resident Geologist's office.

North Bay Area

Kyanite Mining Corporation is the present owner of the Crocan Lake kyanite deposit, located in Butler and Antoine townships. Extensive work has been conducted by various owners since the initial discovery in 1951. Exploration and development work was performed by Golwynne Chemical Corporation of New York from 1952 until 1955. Diamond drilling totalling 2530 feet, as well as considerable trenching and stripping of seven acres, was completed to accommodate an open pit operation which never materialized. Studies reported the existence of 50 000 000 tons of ore amenable to open pit mining. Test work was initiated to determine the feasibility of milling the ore for recovery of kyanite, garnet, muscovite and possibly biotite. The results were encouraging but the project never proceeded.

Kyanite Mining Corporation took over the property in 1974 after 2576 feet of drilling was completed by Canadian Longyear Limited. Since then, bulk sampling was done and test work is continuing to determine the optimum properties of the various minerals. Currently, an environmental assessment is



* not including claim staking activities

Figure 15.4 Exploration activity in the Cobalt Resident Geologist's District.

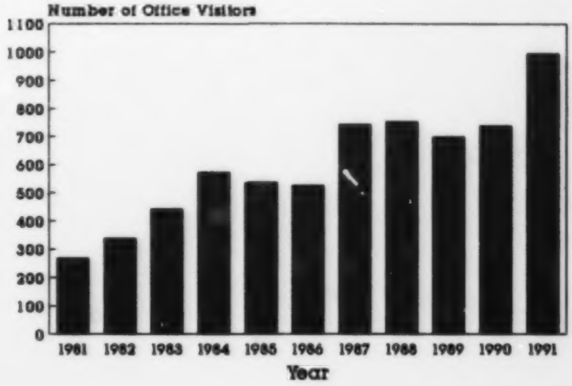


Figure 15.5 Client services—number of visitors to the Cobalt Resident Geologist's Office.

being conducted for the operation of a mill facility and its tailings generation and disposal site. This report is expected to be completed shortly. Once the project's feasibility is established, the possibility of building a 2 megawatt power plant on a nearby river will be reviewed, as the property's distance from Ontario Hydro power makes this option the most viable power source for the project. Small-scale hydro-electric generating systems may be the answer to the successful exploitation of many smaller, isolated mineral deposits not currently being mined.

A mining operation of 1000 tons per day is being proposed with ore reserves generating in excess of 30 years supply. In the meantime, the possibility of running a diesel-generated 100 ton per day pilot plant is also being considered.

Temagami Area

Approximately 34.6 km of combined total field and gradient ground magnetometer surveys was carried out by Aur Resources Inc. on 3 grids in Gooderham Township and 1 grid in Eldridge Township. The program was designed to locate structures favourable for gold or base metals mineralization. A fifth grid in Thistle Township was also surveyed. All claim blocks are located marginal to the Grenville Front (assessment files, Cobalt).

Gwen Resources Limited and Perrex Resources Inc. began exploration activities on patented ground containing the Clenor (Beanland) Gold deposit in Strathy Township. Line cutting, magnetometer and VLF-EM surveys were in progress at the end of November. A bulk sample is planned to test the northeast end of a quartz vein system exposed on surface that had been previously tested by a raise. The proposed size of the bulk sample will be 160 feet by 5.5 feet by 20 feet deep. Expected average grade for the sample with dilution is 0.20 ounces Au per ton. The zone is reported to average 0.33 ounces Au per ton and is estimated to contain 8000 tons. The bulk sample will be shipped to the Kerr mill in Virginiatown for processing by Deak Resources. A small program of diamond drilling is also planned.

According to Fyon and Crocket (1986) the prospect is hosted by mafic volcanic rocks of the Younger Volcanic Complex immediately adjacent to the Vermillion–Net Lake Deformation Zone.

Gold associated with sulphide mineralization is reported to occur in a zone of northeast striking, steeply south-dipping quartz veins, 4 to 5 feet thick. The mineralization consists of up to 20% pyrite, galena and minor amounts of sphalerite and chalcopyrite. The vein system is cross-faulted by 2northerly trending structures which show signs of sinistral displacement.

The prospect was discovered in 1929 by S. Beanland. It was explored during the 1930s by trenching, minor diamond drilling and underground development. The later consisted of the sinking of a 500 foot shaft, 4000 feet of lateral development on the 175, 325 and 475 foot levels and the driving of a raise to surface from the 325 foot level (A. Perron, personal communication, 1991).

Mr. W. Manderstrom completed work on 2 showings in the Temagami area this year.

The property historically known as the Brochu copper occurrence in Cassels Township, east of Boot Bay on Net Lake, has previously been explored by diamond drilling and trenching. Five diamond-drill holes totalling 178 m were completed in 1955 by A. Bouchu. Mineralization exposed by trenching included up to 10% disseminated pyrite, pyrrhotite with minor chalcopyrite, sphalerite and galena. The sulphides are hosted in sheared and altered felsic volcanic rock (Born 1989). Trenching was completed by Hermes Mines Limited in 1945, A. Bouchu in 1955 and by New Athona Mines in 1956. The latter diamond drilled a further 5 holes totalling 445 m. Trenching also exposed several mineralized, 2 to 30 cm wide quartz veins arranged perpendicular to the main diabase-dacite intrusive contact. Veining occurs in both lithologies.

Table 15.3 Maps and reports pertaining to the Cobalt Resident Geologist's District published during this year by the Ontario Geological Survey, Ministry of Northern Development and Mines.

Ontario Geological Survey, Geological Reports	
GR 276	
Ontario Geological Survey, Open File Reports	
OFR 5757	OFR 5807
OFR 5758	OFR 5806
OFR 5793	OFR 5810
Geological Data Inventory Folios	
GDIF 565	GDIF 574
GDIF 568	GDIF 575
GDIF 569	GDIF 576
GDIF 570	GDIF 583
GDIF 571	GDIF 584
GDIF 572	GDIF 586
GDIF 573	GDIF 587
Coloured Maps	
Map 2551	
Map 2552	
Map 80 802	
Geology of Ontario Maps	
Map 2543	
Map 2555	
Map 2586	
Map 2590	

The occurrence is described by a Rio Tinto Explorations Ltd. 1970 assessment report as a 60 to 100 cm wide, well-sheared fault zone striking 050° and dipping 45° to 70° to the south. The zone contains some pyrite and very minor chalcopyrite mineralization.

Work this year consisted of a 257 foot diamond-drill hole collared to intersect the mineralized shear zone at depth. Unfortunately, the target depth was not reached. Earlier, shallower drilling had intersected values of up to 50 feet of 0.5% copper.

The second property is historically known as the Milne gold-silver occurrence. The claims are located in south-central Strathy Township, on the north shore of Link Lake. Moorhouse (1942) mentions a 030° striking quartz vein approximately 200 feet in length and ranging in width from a crack to 12 inches. Mineralization includes disseminated to massive arsenopyrite and pyrite. A 080° striking, sheared rhyolite terminates the vein to the north. Samples from 1941 produced assays from 0.04 to 1.3 ounces Au per ton and from trace to 20.04 ounces Ag per ton over widths of up to 12 inches.

Work this year encompassed one diamond drill hole reaching only 97 feet. A 7 inch pyrite-chalcopyrite zone was intersected at approximately 95 feet downhole before the hole was terminated short of its target (W. Manderstrom, prospector, personal communication, 1991).

Shining Tree Area

Asarco Exploration Co. of Canada Ltd. continued ground follow-up investigations of the previous year's airborne survey release. Work was primarily on the Burrows and Connaught township areas and consisted of line cutting and ground geophysical surveys (HLEM and magnetometer). A single diamond-drill hole, totalling 127 m was completed in Burrows Township. The anomaly was explained as a pyritic graphite horizon (J. Reddick, Asarco Exploration Co. of Canada Ltd., personal communication, 1991).

JVX Ltd. optioned their 140 claim Tyrrell-MacMurchy townships property to BHP-Utah Mines Limited, who subsequently completed an airborne geophysical survey, detailed geological mapping, geochemistry, and 10 to 15 line-kilometres of combined ground geophysical (IP, VLF-EM and magnetometer) surveys on the claim group. Work was centered in Tyrell Township. BHP-Utah is currently diamond drilling on the property.

BHP-Utah also completed a 345 line-kilometre airborne geophysical survey (magnetometer, EM and VLF-EM) over another claim block in Tyrrell and MacMurchy townships currently under option from Goldeye Explorations Limited. Several moderate to low priority geophysical anomalies were defined and recommended for ground follow-up.

Using OPAP funding, M. Caron is currently investigating a 22 claim block in MacMurchy Township. Work completed in 1991 included line cutting, magnetometer and VLF-EM ground surveys as well as lithogeochemical sampling for assaying (M. Caron, Prospector, personal communication, 1991).

The group of E.J. Clark, J. Clark and M. Perkins have completed exploration in Natal Township this year through funding provided by an OPAP grant. Details of this work are not currently available.

Copperquest Inc. completed line cutting and VLF-EM surveys on the Mataris property in Connaught Township, the Ronda property in MacMurchy Township and a single claim property in Asquith Township. Re-staking and line cutting was in progress in MacMurchy Township at the time of writing (J.R.B. Parres, Prospector, personal communication, 1991).

A. Decker continued investigation of a zone of north-trending sulphide mineralization occurring in oxidized komatiitic volcanic rocks in the northeast corner of Natal Township.

A trench was further extended manually across this zone. Subcrop exposure now consists of an area 19.8 m long, 1.8 m wide and 1.5 m deep. Assays of up to 0.5% Ni were obtained from grab samples collected from the zone. Mr. Decker indicated that he may go back at year's end to do some plugger drilling and blasting.

In addition to the above, Mr. Decker prospected on claims held in the southwest corner of Knight Township. Free gold and pyrite mineralization is associated with north-trending quartz veins within a zone of carbonate and fuchsite alteration 30 to 61 m wide. Negotiations are reportedly underway to option the property (A. Decker, Prospector, personal communication, 1991).

Fort Knox Gold Resources Inc. reported encouraging exploration results in Fawcett Township during the current year. The company was investigating coincident magnetic and electromagnetic anomalies defined by the 1990 Ontario Geological Survey airborne geophysical survey of the Shining Tree Area (OGS 1990). A follow-up ground electromagnetic survey and reconnaissance geological mapping located two strong conductive anomalies on two separate grids. By the end of October, 4 diamond-drill holes had been completed to test the anomalies.

On the North grid, anomalous copper, zinc and gold values were obtained from surface sampling of a sericitized felsic tuff that had been traced along a 914 m strike length. One drill hole was completed on the North grid and returned a 61 m intersection of intercalated sedimentary and felsic pyroclastic rocks, within which anomalous copper-lead-zinc values were reported. Previous exploration in this area by Amax Exploration Inc. during 1971 and 1972 included definition of an electromagnetic conductor over a 1600 foot strike length, soil sampling, geological mapping and the completion of one 350 foot diamond-drill hole.

Three diamond-drill holes were completed by Fort Knox on the South grid. Drill hole SG-1 totalled 167.6 m and yielded a 5.5 m intersection of sulphide-rich pyroxenite which assayed 0.53% Ni and 0.45% Cu over 1.2 m (later reported as 1.16% Ni and 0.29% Cu over 1.3 m). A 15.2 m intersection of anomalous copper values was also reported above this zone.

Drill hole SG-2, collared 19.8 m behind the first hole and drilled at a different azimuth, returned assays of 1.03% Ni and 0.43% Cu over 33.48 m within a 65.5 m sulphide mineralized interval.

Hole SG-3, collared 30.5 m northeast of SG-2, intersected two mineralized zones separated by a section of barren dike. The upper mineralized zone returned assays of 1.07% Ni and 0.50% Cu over 9.5 m, while the lower zone returned assays of 1.12% Ni and 0.40% Cu over 14.8 m.

Sulphide mineralization in the South grid discovery zone consists of pyrrhotite, pentlandite, chalcopyrite and pyrite located within a coarse-grained pyroxenite host. A feldspar-porphyritic anorthositic gabbro occurs as both hanging wall and footwall to the mineralized zone. Downhole geophysical surveys have been completed and additional diamond drilling was in progress at the time of writing.

The company currently holds 225 claims in the area. No work was reported for claims held in Asquith and Churchill townships (*The Northern Miner*, July 8, October 28, November 4, November 11 and November 25, 1991; D.A. Humby, W. Waymark, Fort Knox Gold Resources Inc., personal communication, 1991).

D.V. Jones and J.K. Filo hold 43 claims as two contiguous claim blocks located immediately north, west and south of Arthur Lake in Knight and Natal townships. The property was originally staked for it's gold potential but recent OPAP funded exploration on the property indicated good nickel potential related to the Arthur Lake structure. According to Mr. Filo, this structure represents a "deckerite" horizon consisting of a fuchitic and brecciated (possibly tuffaceous) ultramafic unit. Carter (1983) considered "deckerite" to be a komatiitic lapilli tuff having an affinity for nickel mineralization.

Thirty-two line-kilometres of a twin frequency VLF-EM ground geophysical survey completed on the south and western halves of the property have delineated a number of north-trending anomalies. The VLF-EM anomalies, if hosted within komatiitic ultramafic flows, may represent a Kambalda style of nickel-sulphide mineralization. A further 30 line-kilometres of VLF-EM surveying is currently being conducted on the property.

Detailed prospecting and sampling in areas of outcrop outlined a number of new zinc showings associated with felsic metavolcanic rocks. Drill core found on the property was also re-logged. The partners are currently negotiating an option on the property (J.K. Filo, geologist, personal communication, 1991; assessment files, Cobalt).

G. Kent, assisted by geologist C. Suchanek, prospected in Kelvin and Churchill townships supported by OPAP funding. Their activities led to the staking of 4 claims in the area. No further information was available at the time of writing (G. Kent, Prospector, personal communication, 1991).

Partners A. LaCarte and B. MacCallum staked a group of claims in Tyrrell Township in 1990 when the land peripheral to the Temagami Land Caution was lifted. The area was mapped by Carter (1977, 1980, 1989a, 1989b) as a metavolcanic sequence of mafic, intermediate and felsic rocks. Detailed mapping and significant stripping has identified a quartz-carbonate veined fuchsitic unit on the property.

Stripping, rock sampling and diamond drilling were conducted on the property this year. A 102 foot diamond-drill hole was completed near Hare Lake in the northern portion of the property which intersected minor sulphides and returned one assay of 0.113 ounce Au per ton over a narrow width. A second diamond-drill hole was completed in early November, the results of which are pending. The hole was drilled in the southern part of the claim group to test the structure, thickness and mineral potential of the quartz-carbonate veined, fuchsitic unit. This unit exhibits evidence of intense deformation, showing signs of shearing, folding and faulting.

OPAP assisted prospecting by J. Ladouceur on claims held in Asquith Township resulted in a number of rock samples returning anomalous base metal values of up to 1236 ppm Cu and 19 ppm Cr.

One 130 foot diamond drill hole was completed on an area in which 8 surface grab samples assayed slightly anomalous base metal values ranging from 47 to 340 ppm Cu, 31 to 37 ppm Co and 65 and 67 ppm Ni. Split drill core samples returned negligible gold values. Additional drill core was split and submitted for base metal analysis, the results of which are not yet available. The drill core was logged by H. Lovell and is currently stored at the Swastika Drill Core Library (J. Ladouceur, Prospector, personal communication, 1991).

D. Londry and D. Mullen completed a 14 line-kilometre ground magnetometer survey on their 11 claim property in northeast MacMurchy and northwest Tyrrell townships. Magnetic anomalies were interpreted to coincide with local geological units and fault structures. Carter's (1977) mapping indicates that the claim group is underlain by a succession of northwest-trending mafic to felsic metavolcanic flows and minor sedimentary horizons.

Previous exploration in the immediate area of the claim group included work by W.D. Sutherland and Associates, who completed 7 diamond-drill holes totalling 667 m in 1966–67. Mariposite, minor pyrite, pyrrhotite, chalcopyrite and hematite mineralization were reported.

T. Obradovich, R. Crighton and W. Egg explored a 5 claim property in east-central MacMurchy Township assisted by OPAP funding. Three gold showings are known on the property, which is underlain by a metavolcanic assemblage of mafic, intermediate and felsic lithologies. The property has been active periodically since 1931. Four vein systems have been documented on the property but Carter (1977) was able to locate only 2 of those 4.

The north-trending Netherton Vein and a northeast-trending shear zone occur within the southern half of the property. This shear zone is considered to be a splay off the northward trending Jess Lake fault which transects most of the township. The intersection of this splay shear and a north-trending structure marks the location of the Brunet gold occurrence. The northern portion of the claim group hosts the extension of the north-trending Blacksmith Vein.

A 14.0 line-mile airborne magnetic and VLF-EM survey was conducted by the current claim holders over the property. VLF-EM results indicate a possible shear zone in the northern part of the claim group. No further information was available at the time of writing.

Queenston Mining Inc. and Noront Resources Limited formed a 50/50 joint venture partnership to acquire and explore a 31 claim group in Fawcett Township in November, 1991. The claims are located east of the Fort Knox property, where nickel-copper mineralization was discovered in diamond-drill core this past summer. The Queenston-Noront property reportedly hosts lithologies and magnetic anomalies similar to the adjacent Fort Knox ground. The joint venture agreement includes a commitment to spend $300 000 in exploration on the property over a 2 year period. Line cutting and geophysical surveys are expected to begin in January 1992 (*Kirkland Lake Northern Daily News*, November 14, 1991).

S. Ryan, aided by J.K. Filo, completed an OPAP funded exploration program which included approximately 6 km of line cutting, ground magnetometer and VLF-EM surveying, prospecting and geological mapping on his claims in MacMurchy Township. Bedrock sampling returned no significant gold values, however, a number of untested VLF-EM conductors were defined (J.K. Filo, personal communication, 1991).

N. Saville prospected and trench blasted on a high-grade silica occurrence, described as a 98.5% SiO_2 quartz vein blowout, in the northeast corner of Asquith Township. An investigation of the marketing potential for this material as either a source of silica or as ornamental stone is in progress. In addition, a number of gold prospects were staked and sampled, the assay results of which are still pending (N. Saville, Prospector, personal communication, 1991).

Skead Holdings Limited reported the completion of combined ground geophysical (magnetometer and VLF-EM) and geological surveys on a number of claim groups in the vicinity of Big Four Lake, MacMurchy Township and in the eastern half and extreme northwest corner of Tyrell Township (assessment files, Cobalt).

J.L. Tindale completed approximately 16 km of line cutting, geological mapping and combined ground magnetometer and EM surveys on claims held in Kelvin Township. The western half of the claim block was surveyed using a shoot-back EM system while the eastern claims were surveyed by VLF-EM.

Grab samples returned only background base metal and gold values. The interpretation and correlation of new and previously compiled data is currently in progress (J.L. Tindale, Prospector, personal communication, 1991).

A 15 claim property held by J.L. Tindale, R. Annett and R. Ferguson, located in the southwest corner of MacMurchy Township, was explored with funding aid provided by an OMIP grant. The claim group lies in the area of Hassett Lake on the MacMurchy-Fawcett townships boundary, bordering the Fort Knox claim group, and is underlain by a sequence of mafic to intermediate volcanic rocks. A total of 7 miles of line cutting, detailed geological mapping, and ground VLF-EM and magnetometer surveys were completed. The partnership recently entered into a 3 year option agreement for the property with Goldhunter Explorations Inc. (J. Tindale, prospector, personal communication, 1991).

H. Tittley, L. Salo and J. Salo are pursuing the source of an auriferous float occurrence in Burrows Township using OPAP funding. The partners completed line cutting, geological mapping and a detailed ground magnetometer survey (total field and gradient) on the western half of the property. Grab samples of the quartz vein float material taken during a property visit by the Resident Geologist returned assay values of 2.915 ounces Au per ton and 4.72 ounces Ag per ton. The partners are attempting to trace this material in the up-ice direction back to it's source location. A further description of this property is contained within the "Property Examinations" section of this report (H. Tittley, Prospector, personal communication, 1991).

Trinity Explorations holds 20 claims on the north shore of Elephant Head Lake in Connaught Township. The claims encompass the "Saville Polymetallic Occurrence" located approximately 0.5 miles north of the lake. During the spring, the company completed an airborne magnetic and EM survey which defined 1 strong magnetic high signature centred over the main showing. Nine significant electromagnetic anomalies were outlined, 4 of which are located proximal to the main copper-zinc-silver-gold showing.

A grab sample from the main showing, collected by Royal Aggassiz Mines Limited, in 1971 assayed 10.80% Cu, 0.23% Zn, 4.90 ounces Ag per ton and 0.10 ounces Au per ton from within a 4 foot massive sulphide interval, while a grab sample taken in a lower grade section of disseminated sulphides in the wall rock returned values of 1.52% Cu, 0.04% Zn, 0.72 ounces Ag per ton and 0.07 ounces Au per ton. The mineralized zone was exposed within a freshly blasted trench and was described as being at least 12 feet wide, striking northwest and hosted in rhyolite adjacent to a highly magnetic iron formation. The occurrence was described by Carter (1980) as being located in Espanola Formation limestone near the contact between granitic rocks and Early Precambrian rhyolitic metavolcanic rocks: "The deposit consists of a 3.0 to 3.7 m wide calcite vein striking 010° and dipping 80°NE. Mineralization consists of magnetite and massive chalcopyrite, pyrite, bornite, malachite, and azurite associated with recrystallized calcite, tremolite, actinolite, and epidote and lying near aphanitic light pink rhyolite".

Proposed work by Trinity Explorations includes line cutting, ground geophysics (HLEM, VLF-EM, and magnetometer), prospecting and geological mapping (G. Mullins, personal communication, 1991).

Tyranex Gold Inc. continued exploration on the Tyranite gold mine property which straddles the boundaries of Tyrrell and Knight townships. A 914 m surface diamond-drilling program was underway late in 1991. The current drilling is designed to test the Northlands structure immediately north of the existing mine workings. This northern extension of gold mineralization was discovered in 1987 by diamond drilling. The surface expression of the zone was extensively stripped and sampled in 1990 (V. Popov, Tyranex Gold Inc., personal communication, 1991; *Kirkland Lake Northern Daily News*, November 19, 1991).

A gold property, owned by numbered company 858277 Ontario Inc. in northeastern Bryce Township, consists of 4 patented claims and 3 staked claims. Previous work on the property includes three shallow shafts sunk by G. Whitton prior to 1940. The property has since been subjected to a significant amount of prospecting, trenching, sampling and diamond drilling, primarily in the last 3 years by the present owners. This recent work has resulted in the discovery of several new gold occurrences (Resident Geologist's files, Cobalt).

Additional work is planned to search for the presence of further carbonate-fuchsite units, believed to be the most favourable host for gold mineralization (A. LaCarte, Prospector, personal communication, 1991).

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

During the year, the Cobalt office was staffed by: Acting Resident Geologist J. Ireland who became Resident Geologist in mid-July of this year; Staff Geologist, E. Basa; Secretary, J. Price; Contract Geologist, R. Zalnieriunas; and Experience 1991 Student, S. Dalley.

A. Beecham was contracted in October, 1990, to complete the Geoscience Exploration Database (GED) by March 1991. R. Zalnieriunas was contracted in November, 1991, to assist J. Ireland with both the Resident Geologist's and Manager of Temiskaming Testing Laboratories positions. Staff Geologist E. Basa began a maternity leave in late November.

In reaction to the opening of certain lands peripheral to the Temagami Land Caution in 1990, office research and field exploration increased significantly over the year. Office use by clients increased by 14% from last year to 923 visitors—an all time high for the office since reopening in 1981.

The Geoscience Exploration Database (GED) project, initiated in the fall of 1990, was completed this spring and excerpts from a summary report written by the contractor are included in this report. A great deal of information was gained through this work and our Mineral Deposits Inventory (MDI) database, consisting of approximately 500 records, is now current and up to date.

Other staff activities included reviewing and commenting on land use issues, Ministry of Natural Resources Timber Management Plans and the mineral potential of the Temagami and Elk Lake areas. Staff also responded to several Ministry of Natural Resources and Ministry of Environment requests for mineralization quantification and identification of waste rock being used in local waterways. Assistance was given to Cobalt's Northern Ontario Mining Museum by providing various hand-out materials and miscellaneous labour performed by our Summer Experience '91 student.

Ontario Mining Week was held during the first week in June this year. The office held an Open House and offerred guided tours through both the Resident Geologist's offices and the Temiskaming Testing Laboratories. In addition to this, the Staff Geologist manned an information display booth at the local mall in New Liskeard. Interest shown has increased over the previous year, with many of the town's senior citizens and local prospectors turning out for the tours and open house.

Geological field trips promoting area geology and particularly the base metal potential of the Cobalt camp were provided for a number of professional groups. One local geology tour was given to a number of graduate students of Virginia Polytechnical Institute in the spring. A geology and Heritage Silver Trail Tour were given for a number of Ministry representatives this summer. Several local school field trips were also given by the Resident Geologist.

Assistance is being provided to the Haileybury School of Mines to develop and maintain a new local geophysical test site. The site will be utilized by field schools, local field trips and government-assisted field courses for representatives from the minerals industry and prospectors. The test site had been offerred for use by a local prospector who has recently optioned the claims. The optioner has agreed to the use of the property by the Haileybury School of Mines.

Presentations made by the staff this year included a poster display at the annual Mines and Minerals Symposium in Toronto in December, 1990 and 1991. The 1990 poster depicted the exploration activity in the Cobalt district over the year while the 1991 display depicted a geological compilation of the Shining Tree area, with emphasis on recent work by Fort Knox Gold Resources Inc. in Fawcett Township. The former display was also presented at the Northeast Region Geoscience Seminar in Kirkland Lake in April of 1991. Also presented at the 1990 Toronto and 1991 Regional seminars was a display showing the laboratory work and a scaled model of the sampling procedures of Temiskaming Testing Laboratories.

Staff attended several professional seminars and training sessions during the year, including the Prospectors and Developers Association of Canada convention, Geological Association of Canada-Mineralogical Association of Canada-Society of Exploration Geologists Joint Annual Meeting, Interpretation course in Mining Geophysics for Prospectors, Kirkland Lake Geology field tour, Toronto Mines and Minerals Symposium and Northeast Region Geoscience Seminar.

The Resident and Staff geologists visited approximately 23 active and non-active properties to provide assistance and act as liaison between individual prospectors and junior and major mining companies. An additional 10 non-active properties were also visited to obtain additional information on the geology of the area.

The Staff Geologist began a French upgrading course in the spring which was resumed in the fall of this year.

NORTHERN ONTARIO DEVELOPMENT AGREEMENT (NODA) ACTIVITIES

C. Marmont (Ministry of Northern Development and Mines, Dorset) began an investigation of the economic potential of Industrial Minerals and Building Stone in Central Ontario. The program is part of the Northern Ontario Development Agreement (NODA), which is a subsidiary of the Canada-Ontario Economic and Regional Development Agreement (ERDA). The study area includes the districts of Parry Sound and Nipissing within the Algonquin Resident Geologist's district and those parts of the Sudbury and Cobalt Resident Geologist's districts south of the Grenville Front. The program was recently described by Marmont (1991).

During 1991, 3 sites were examined in the Cobalt Resident Geologist's district for their building stone potential. Investigations were completed in McLaren, Milne, and Stewart townships. Two 400 kg blocks of granite, collected from the Milne and Stewart township sites, were sawn into thin tiles and polished by Khouri Granite Ltd. in Sudbury. Samples are available for viewing at the Resident Geologist's offices in Dorset and Cobalt. A summary report containing additional descriptions of the sample sites and the prepared tiles is in preparation, for release early in 1992.

Milne Township

A fine- to medium-grained, equigranular red granite or granodiorite is exposed in a number of small outcrops in central Milne Township (Universal Transverse Mercator (UTM) 599200E, 518500N; National Topographic System (NTS) 31L/13). The granite was mapped by Lumbers (1969, 1971) as an Archean granite within the Grenville Province. The stone appears to be uniform and sparsely jointed. Two distinct phases of granite were identified, and further detailed inspection, including stripping and additional sampling, would be required to properly evaluate the site's potential. Much of the outcrop exposure is located on the flank of a stepped plateau with a moderate northwest slope that would facilitate quarrying.

The site is accessible via a good logging road from Highway 11.

Stewart Township

A preliminary survey of a portion of the Mulock Batholith in central Stewart Township revealed a broad area of small outcrops displaying only a single, widely spaced joint set. The stone is relatively homogeneous within limits and is weakly to moderately foliated. Less-deformed parts exhibit slightly rounded, large crystals (porphyroblasts?) of pink feldspar within a finer-grained matrix of quartz, feldspar and biotite. More deformed phases exhibit foliation and/or lineation which imparts a preferential gneissosity to the stone. The stone appears to be sound and not porous. The area has moderate topographical relief and further investigation is warranted to identify potentially suitable quarry sites.

The area of interest lies southeast of Tilden Lake (UTM 615500E to 619000E, 5157800N to 5161000N; NTS 31L/11) and is accessible via logging road from Highway 11.

McLaren Township

A small body of granite along Highway 11 near Marten River and a similar small, previously unmapped granite body on the northeast side of Findlayson Lake were examined. Both exposures are similar in composition, texture and colour to the Mulock Batholith examined in Stewart Township, but the rock exhibits moderate jointing.

The Findlayson Lake site is accessible via bush road from Highway 11, south of Frenchman's Bay (UTM 592100E, 517850N; NTS 31L/12).

PROPERTY EXAMINATIONS

Breault Quarry, Dymond Township

The Breault Quarry is situated on Lot 11, Concession 6, Dymond Township, approximately 8 km north of New Liskeard. The site is approximately 2 km east of Highway 11 North and accessed via the Harley-Dymond townships boundary road. The property is owned by C. Breault, a local farmer, and is currently under option to Dymond Lime Products of Haileybury.

Dymond Lime began initial evaluation of the Breault site in 1988, predicated on the results of a diamond drilling program carried out by the Ministry of Northern Development and Mines as part of an evaluation of the Lake Temiskaming Paleozoic Outlier (Grant and Owsiacki 1987).

The detailed geology of the Lake Temiskaming Paleozoic Outlier is well documented by Russel (1984), Lovell (1977), Lovell and Frey (1976), Bolton and Copeland (1972), Thompson (1965), Sinclair (1965), Ollerenshaw and MacQueen (1968), Goudge (1938), Hume (1925) and Wilson (1918). The Lake Temiskaming Paleozoic Outlier consists of Ordovician- to Middle Silurian-aged sedimentary rocks comprised predominantly of limestone and dolostone with subordinant shale and sandstone. The Paleozoic rocks are preserved within a northwest-elongated basin formed by down-faulting within the Temiskaming rift system. They are in fault contact with Precambrian rocks to the southwest and northeast and unconformably overlie Precambrian rocks to the northwest. The southeast limit of the outlier is hidden beneath Lake Temiskaming, however, small isolated outliers of Paleozoic strata unconformably overlie Precambrian rocks on both sides of Lake Temiskaming, south of the main body of the Temiskaming Paleozoic Outlier.

The Breault Quarry is developed in Middle Silurian-aged rocks of the Thornloe Formation, the youngest rocks recognised to date in the Temiskaming Paleozoic Outlier, comprised of buff-coloured, thick-bedded crystalline dolostone containing variable chert as nodules and fossil replacements. Rocks in the area of the Breault Quarry contain large, lenticular remnants of undolomitized limestone grading up to 55% CaO. It is within this latter facies that quarry development has been established.

A detailed examination of the quarry wall in the vicinity of the discovery drill hole, MNDM-7, revealed the following section (*see* Figure 15.6).

CHITARONI GOLD OCCURRENCE, BUCKE TOWNSHIP

The Citaroni gold occurrence is located in southwest Bucke Township, exposed in a rock cut on the west side of Highway 11 North, approximately 6.4 km north of the Cobalt turnoff. The showing was discovered in May, 1991 by G. Chitaroni, a local geologist and prospector.

The area is underlain by gently northwest-dipping, purplish-grey weathering, laminated argillites interbedded with 0.1 m to 0.6 m thick wackes of the Firstbrook Formation. The Firstbrook Formation conformably overlies conglomerates and greywackes of the Coleman Formation, the basal member of the Cobalt Group of Huronian-aged sediments.

A vertically-dipping, variably altered, quartz-diabase dike of Late Precambrian age intrudes the Huronian sediments and forms a prominent 350° trending regional lineament. At the south end of the quartz diabase exposure, a 13 m wide, 258° trending, unaltered, fine-grained mafic dike of possible diabasic affinity also intrudes the Huronian sediments. The intrusive relationship between the two mafic dikes is uncertain, but it appears that the 258° trending dike cuts the 350° trending dike.

North of the intersection of the two dikes, the main 350° trending quartz-diabase dike is severely fractured and jointed in at least three directions; 340° to 005°, 270° to 290° and 250° to 260°. All fractures and joints are steeply dipping to vertical. Significant quartz and epidote containing minor disseminated hematite, magnetite, chalcopyrite and malachite occupy the first two joint sets. Silicification, epidotization and mineralization extend up to 0.5 m into the diabase from the mineralized joints and fractures. In the 340° to 350° joint set, slickensides, evidenced by the development of fibrous epidote, indicate horizontal movement along the joint planes.

A 0.2 m to 0.6 m wide quartz-carbonate-epidote vein trending roughly 270° and dipping 28° to 40° north, cuts the quartz-diabase dike within the zone of quartz-epidote alteration. The vein and altered wallrock contain variable amounts of hematite, magnetite, chalcopyrite and malachite (*see* Figure 15.7).

The footwall of the main quartz-epidote vein exhibits extensive fracturing, jointing and minor shearing. An 8 cm wide ribbon quartz vein, trending 348° and dipping 80° west, occupies one such shear located 5 m south of the main quartz-epidote vein. This vein is distinctive as it contains minor chalcopyrite but no epidote.

Chip and grab samples of the various mineralized zones encountered while mapping returned gold values ranging from trace to 0.086 ounce Au per ton. The highest gold value was obtained from the 8 cm wide ribbon quartz vein mineralized with minor chalcopyrite, located in the footwall of the large quartz-epidote vein.

Albert Decker Nickel Occurrence, Natal Township

From 1978 until 1990 no claims were allowed to be recorded or leased in this area because of the Temagami Land Caution, therefore it was by-passed for financing during the flow-through share financing boom in mineral exploration.

On recently staked claims, A. Decker (Prospector, personal communication, 1991) obtained samples from near a river bank between Pigeon and Arthur lakes that yielded assays as high as 0.34% and 0.49% Ni. The Ontario Prospectors Assistance Program funding allowed for 3 Winkie diamond-drill holes to be completed in 1990, but bouldery overburden and rusty-leached bedrock resulted in poor core recovery.

Spinifex texture can be seen in trenches stripped to bedrock and in drill core, indicating komatiitic basalt might directly overlie a sulphide stratafer (i.e., low grade sulphide iron formation). Where exposed in the trench, this stratafer is composed of pyrite cubes (in places), white calcite, sericite, chlorite and silica. A sample chipped by Consultant Geologist C. Cheriton across 2.4 m of this stratafer and assayed by the writer contained 785 ppm Ni, less than 10 ppb Pd, and nil Au. The possibility remains that, somewhere along the contact of the komatiite with the underlying stratafer, the sulphur from the stratafer has allowed the average background nickel from the komatiite to be concentrated to ore-grade through sulphurization.

A. LaCarte-R. McCallum Gold Occurrence, Tyrrell Township

Access to the property is gained from Highway 560 west of Gowganda, by turning south towards the Matona shaft and proceeding in the direction of Hydro Creek along recent clear-cut logging roads. The area had undergone limited exploration prior to 1990 due to dense bush cover when mapped by Carter (1977) and subsequent withdrawal from staking in 1978 due to proximity to the Temagami Land Caution.

Rock types observed on the property include: 1) turbidites; slate; 3) calc-alkalic flows and intrusives; 4) spinifex-textured komatiite that incorporated calcareous sediments so as to become carbonatized green-mica (fuchsite) bearing rocks; 5) conglomerate containing cobbles of black chert, sandstone and mudstone, the matrix of which is rusty carbonate and siliceous sand and cement; and 6) sulphide statafer (i.e., low grade iron formation). Facing directions are to the northeast while others are towards the southwest as a result of soft sediment slumps, basin closure and tectonic folding. Rock types recur across strike because of the folding and also stratigraphic repetition.

Visible gold is present in quartz stringers cutting calc-alkalic and green-mica-bearing carbonate rocks adjoining a sulphide stratafer west of Hare Lake. The 1 short hole diamond drilled by the prospectors intersected numerous short lengths ranging up to 0.1 ounce Au per ton.

Approximately 1 claim length farther west, Consultant Geologist C. Cheriton (personal communication, 1990) obtained an assay of 5 g/t Au across 0.6 m of graphitic schist. Adjacent to the west, is a thin stratum of siliceous, slightly rusty carbonate rock which grades into massive carbonate rock further to the west. Except for the absence of jaspilite (only gray and black chert having been seen on these claims), this section is similar (in miniature) to a standard section from Carlin Nevada; gold-bearing carbonaceous sediments, underlying low grade gold-bearing silicified limestone to barren footwall limestone.

Marshall Property, Ingram Township

The Marshall property is located in northeast Ingram Township, approximately 16 km east of the town of Englehart. Access to the property is via Highway 659, east from Highway 11, to the Sherriff Lake road, then northeast past Sherriff Lake to the Marshall farm. The main showings are located at the southwest end of Mallard Lake, on the west side of Ingram Creek.

There are several small argentiferous, sulphide mineralized quartz-calcite vein occurrences documented on the property. These have been evaluated sporadically by the Marshall family since 1937. Older existing pits are believed to date back to the early 1900s. The property straddles the contact between Proterozoic-aged Nipissing diabase to the south and sediments of the lower part of the Cobalt Group, also of Proterozoic age, to the north.

All of the known silver-base metal showings occur within the Nipissing diabase, which varies in thickness from 60 m to greater than 100 m in the vicinity of the main showing. The diabase is fine to medium grained, hypersthene bearing and is typical of the lower portion of similar diabase sills occurring in the Cobalt area. Three vertical joint sets are evident in the diabase, the dominant set oriented at 030° and the subordinate sets oriented between 060° to 090° and 140° to 160°. On weathered surfaces the polygonal jointing is often rusty due to the presence of lead, copper, zinc and iron sulphides in the joint planes.

Recent stripping on claim L.822224 revealed narrow, 0.5 cm to 20 cm wide mineralized quartz-calcite veins occupying a sheared east-trending joint and a sheared northeast-trending joint. The two veins are variably mineralized with chalcopyrite, pyrite, galena and minor sphalerite. The northeast-trending structure is more intensely sheared and better mineralized. An old blast pit located approximately 50 m northeast of this showing has exposed a 60 cm wide, northeast-trending vein containing abundant galena at a depth of 3 m. The same vein at surface measures 5 cm wide. The pinch and swell nature of the veins is quite pronounced.

Previous sampling of the galena-rich vein in the blast pit returned values of 7.04 % to 13.30 % Pb, 0.42 to 6.60 ounces Ag per ton, 0.34 % to 5.52 % Cu, 0.50 % to 3.38 % Zn plus trace amounts of cobalt and gold. Recent sampling confirmed the earlier results. The recently exposed narrow veins had not been sampled at the time of the visit.

In September of this year, F. Marshall completed a 201 foot diamond drill hole designed to test a recently exposed northeast-trending vein further south along trend. Numerous narrow, 2 mm to 30 mm wide, sulphide-bearing quartz-calcite veinlets and stringers were observed throughout the core length. At a down hole depth of 166 feet, a 1.1 m wide shear zone was encountered, cutting the core axis at 45°. A 36 cm wide (20 cm true width) zone of quartz veining hosting abundant chalcopyrite, galena and pyrite occurs within this shear. The 36 cm section averaged 7.72 % Cu, 3.53 % Pb, 0.75 % Zn, 1.46 ounces Ag per ton and 0.012 ounce Au per ton.

Tittley–Salo Property, Burrows Township

The Tittley–Salo property is located in west-central Burrows Township, on the east side of Mouse (Jumping Moose) Lake, approximately 27 air-kilometres northwest of Shining Tree. The property is accessed via the Grassy Lake road north from Hwy 560 to Kemp Township, then west on the Marne Lake road. A tertiary bush road leads to the property from Marne Lake.

During 1991, partners H. Tittley and L. and J. Salo completed line cutting, geological mapping and detailed ground magnetometer surveys over the west half of the property. The exploration program is attempting to locate the source of gold-bearing mineralized float which occurs on the property. Samples of this float material assays several ounces Au per ton and is associated with unknown tellurides.

The float occurrence was first described by W.S. Savage, former Resident Geologist in Kirkland Lake, during a visit to the Dominion Gulf Co. property in 1951. Savage described the float as: "A large jagged block of rusty float (about the size of a small car) was found in 1950 near the northwest corner of claim S-55400...The rock appears to have been a basic volcanic with well developed gneissosity cut by an irregular series of quartz veins some of which are up to 6" in width. The quartz is well pyritized and contains visible gold. Fine stringers of a silvery white mineral which might be a telluride can also be seen. One grab sample is said to have given a gold assay of over $100.00 per ton".

EXPLORATION HISTORY

As part of the Dominion Gulf Company's evaluation in 1951, 4 diamond-drill holes were completed in the vicinity of the mineralized float. No assay results were reported.

In 1975, Hollinger Mines Limited diamond drilled 4 additional holes in the vicinity of the mineralized float. Three of the Hollinger holes were drilled to test the extent of iron formation on the property and 1 hole tested a conductor north of the previous drilling. No anomalous gold values were reported. The conductor was explained by the presence of siliceous, graphitic iron formation.

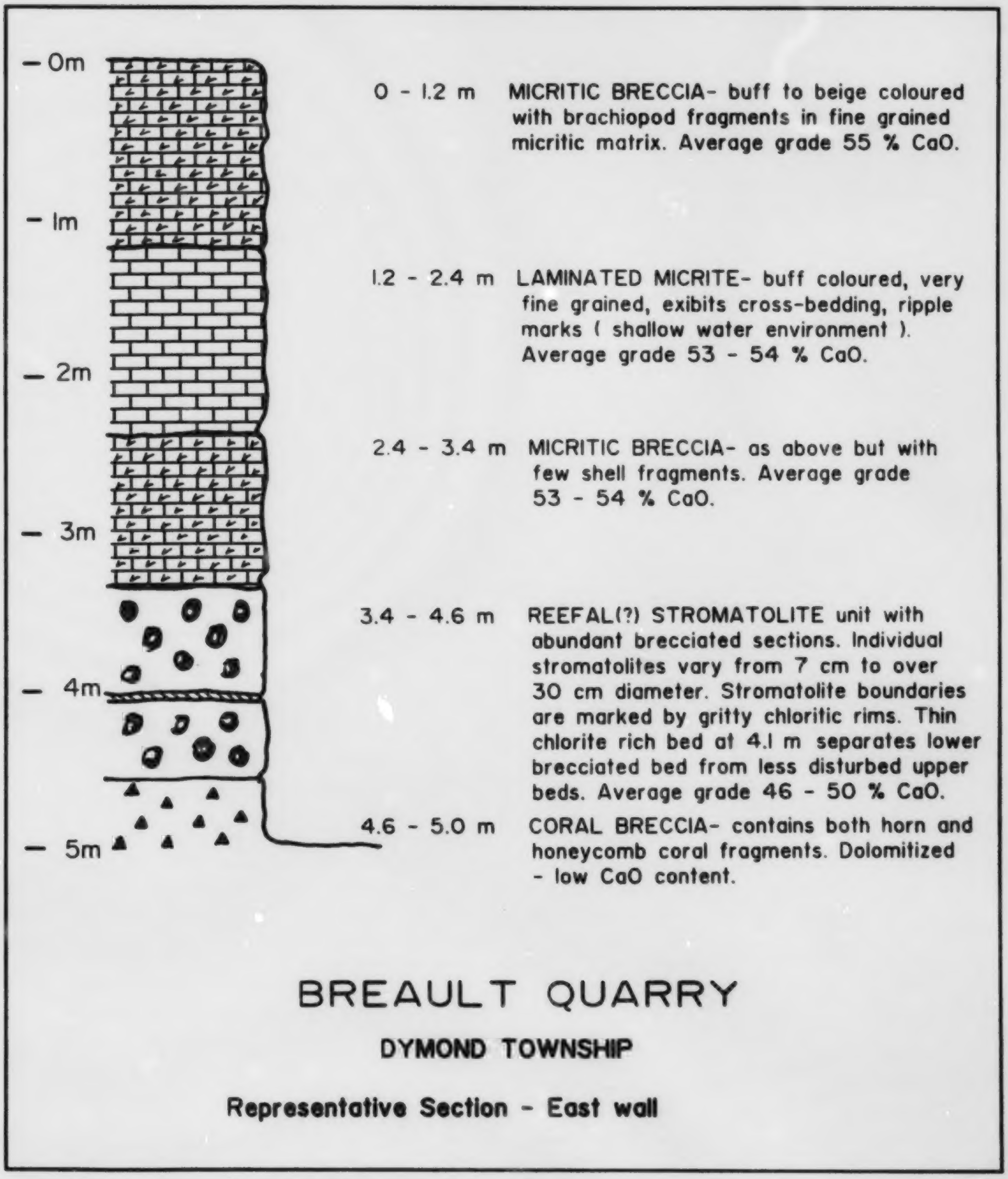
The area was re-staked in 1980 by Messrs. Sirola and Karvinen, who completed a preliminary assessment of the property that included geological mapping, overburden examinations, trenching and sampling. In 1982, the partners optioned the property to Newmont Exploration of Canada Ltd., who carried out a detailed assessment of the property as part of a large program in Burrows and Kemp townships.

Newmont gridded the property and completed geological mapping, ground magnetometer and VLF-EM surveys, overburden till sampling, induced polarization profiling, a resistivity survey and a HLEM survey. Newmont subsequently diamond drilled 3 holes in the vicinity of Mouse Lake to test geophysically delineated targets and also to help define the complex stratigraphy underlying the property. The company stripped and sampled outcrop near the mineralized float location in an effort to find it's source. No source was found.

In 1987, Argentex Resource Exploration Corp. acquired an option on the Sirola–Karvinen property and completed line cutting, geological mapping, and humus geochemical sampling prior to diamond drilling 10 holes totalling 4026 feet. Eight holes were drilled to test a blue-quartz-eye tuff unit believed to be the source of the mineralized float. Gold values were reported from 3 of the 8 diamond drill holes. The best assay was 0.203 ounce Au per ton over 3.6 feet from a fault zone in felsic pyroclastic rocks encountered in hole BA-87-4. Argentex dropped the option on the property and the claims were allowed to lapse.

CURRENT PROGRAM

Data obtained from detailed geological mapping and a magne-



0 - 1.2 m MICRITIC BRECCIA- buff to beige coloured with brachiopod fragments in fine grained micritic matrix. Average grade 55 % CaO.

1.2 - 2.4 m LAMINATED MICRITE- buff coloured, very fine grained, exibits cross-bedding, ripple marks (shallow water environment). Average grade 53 - 54 % CaO.

2.4 - 3.4 m MICRITIC BRECCIA- as above but with few shell fragments. Average grade 53 - 54 % CaO.

3.4 - 4.6 m REEFAL(?) STROMATOLITE unit with abundant brecciated sections. Individual stromatolites vary from 7 cm to over 30 cm diameter. Stromatolite boundaries are marked by gritty chloritic rims. Thin chlorite rich bed at 4.1 m separates lower brecciated bed from less disturbed upper beds. Average grade 46 - 50 % CaO.

4.6 - 5.0 m CORAL BRECCIA- contains both horn and honeycomb coral fragments. Dolomitized - low CaO content.

BREAULT QUARRY

DYMOND TOWNSHIP

Representative Section - East wall

Figure 15.6 Quarry wall section, Breault Quarry, Dymond Township.

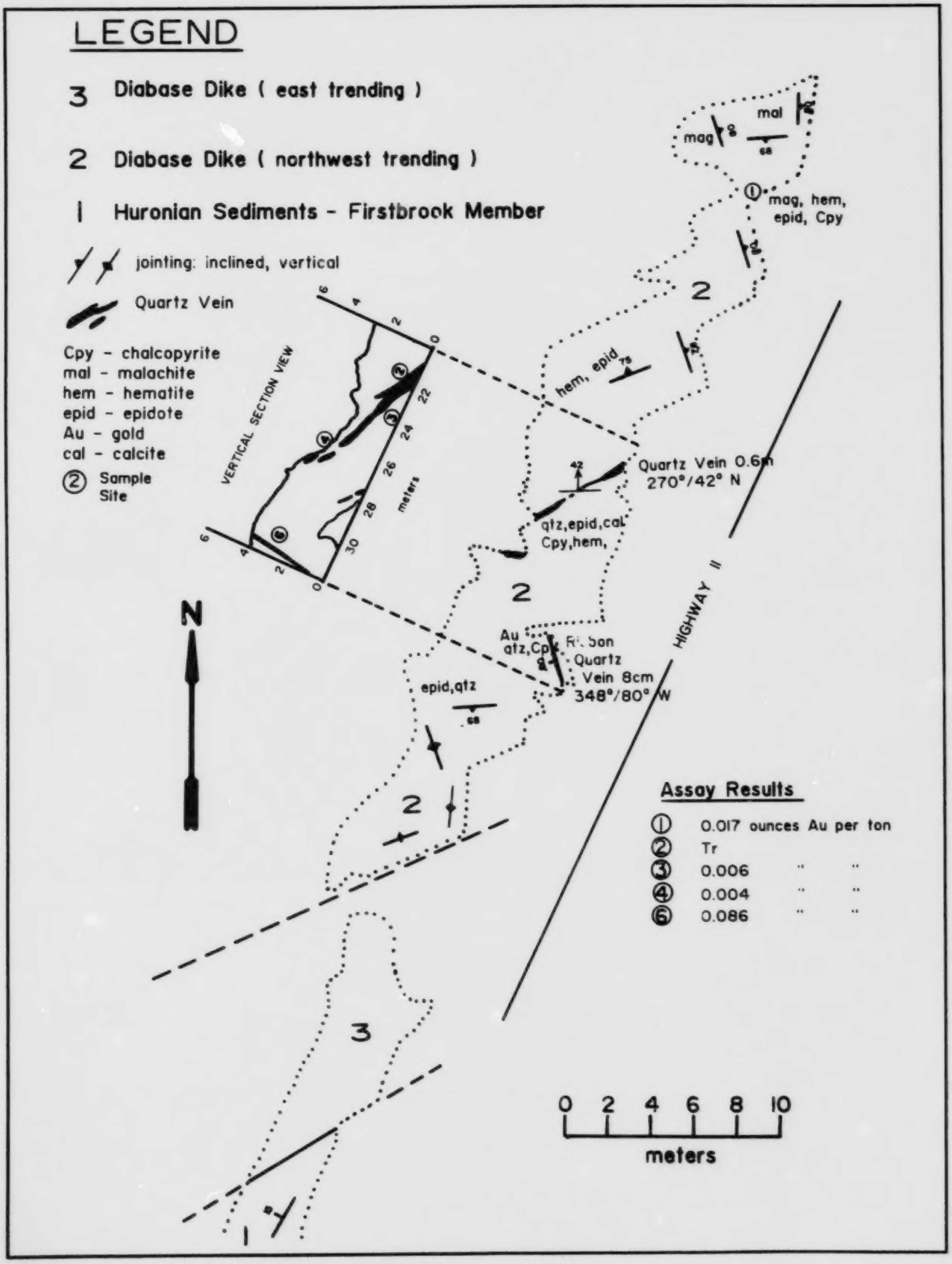

LEGEND
3 Diabase Dike (east trending)
2 Diabase Dike (northwest trending)
1 Huronian Sediments - Firstbrook Member
jointing: inclined, vertical
Quartz Vein
Cpy - chalcopyrite
mal - malachite
hem - hematite
epid - epidote
Au - gold
cal - calcite
② Sample Site
VERTICAL SECTION VIEW
meters
N
mag
mal
mag, hem, epid, Cpy
hem, epid
Quartz Vein 0.6m
270°/42° N
qtz,epid,cal
Cpy,hem,
Au
qtz,Cpy
Ribbon Quartz Vein 8cm
348°/80° W
epid,qtz
HIGHWAY 11
Assay Results
① 0.017 ounces Au per ton
② Tr
③ 0.006 " "
④ 0.004 " "
⑥ 0.086 " "
0 2 4 6 8 10
meters

Figure 15.7 Geology of the Chitaroni Gold Occurrence Township.

tometer survey completed at 20 m line spacing has enabled the partners to re-interpret the complex folding and distribution of structures on the property. They believe that glacial evidence indicates the high grade gold-telluride bearing float did not come from the blue quartz eye tuff unit drilled by Argentex in 1987. Although the float occurrence is immediately down ice from this horizon, no tellurides were reported in the Argentex drill core assays. The new interpretation suggests that the source may be further up ice and associated with tensional cross structures located in the nose of the folded iron formation, under Mouse Lake.

Most of the mineralized float located to date is stock piled in a single location on the property. Previous workers combed the area of the initial discovery and have amassed a sizeable collection of boulders, up to 3 m^3 in size. Although all the mineralized float found to date comes from the immediate vicinity of the initial float discovery, no effort was made to document their initial locations. A detailed survey of their initial resting sites may have provided a scatter diagram or distribution diagram that pointed to the exact source location.

The accumulated boulders are mostly quartz-carbonate vein mineralized with pyrite, minor chalcopyrite and a steel-blue unidentified telluride. The veins are largely intact and range in width from 1 cm to 80 cm. Sulphides occur as pods and the overall vein content is highly variable from trace to semi-massive. No visible gold was identified. Wall rock adjacent to the vein is a highly foliated biotite-chlorite schist with minor opalescent blue quartz eyes. Two to five percent pyrite is present in most wallrock samples.

A representative grab sample of the mineralized quartz-carbonate vein collected by the Resident Geologist returned 2.915 ounces Au per ton and 4.72 ounces Ag per ton while the wall rock material returned 0.018 ounce Au per ton and only trace amounts of Ag. Analyses for tellurium content were unavailable at the time of writing, but recent analyses by the claims holders returned values up to 0.05 % Te in the vein material.

DIAMOND-DRILL CORE STORAGE PROGRAM

A total of 897.6 m of drill core, representing 38 holes, was being stored at the Cobalt Drill Core Library, in 1991, for Golder Associates Limited. All of this drill core was collected as part of the Hazardous Lands Abatement Program funded by the Ministry of Northern Development and Mines in Cobalt. It is anticipated that this core will be donated to the facility.

Additional core offerred to the core library and now being processed consists of 2862 m of core from Bryce Township drilled by Gold Fields Canada, 139 m of assessment drilling by L. Gondor in Robillard Township, 61 m from J. Gore in South Lorrain Township and 228 m from G. Chitaroni in Coleman Township. An undetermined amount of recently recovered and re-logged historical core from Natal Township has also been offered by K. Filo.

Table 15.4 Summary of drill core stored at the Cobalt drill core library.

Township	Total Number Drill Holes	Total Length (m)
Armstrong	1	16
Bucke	54	5042
Casey	1	82
Churchill	3	327
Coleman	241	4247
Dymond	1	300
Firstbrook	25	4879
Harley	4	62
Harris	9	798
Lorrain	11	1196
Mattawan	3	378
South Lorrain	2	901
Strathcona	7	1185
Strathy	25	1560
Total =	390	20972

The cumulative length of core stored in the facility remained unchanged from the previous year, at 20 971.9 m (Table 15.4).

RECOMMENDATIONS FOR EXPLORATION

A.W. Beecham Geological Services was contracted by the Ministry of Northern Development and Mines to update the Mineral Deposit Inventory (MDI) for the Cobalt Resident Geologist's office as part of the Geological Exploration Database (GED) initiative. As this company reviewed the large amounts of data pertaining to the entire Resident Geologist's area, notes of the highlights of their observations were made, many dealing in particular with information they thought was not generally known or published. In addition, the company's extensive exploration experience in northeastern Ontario and northwestern Quebec has been incorporated into the notes and observations.

Upon completion of the project, A.W. Beecham Geological Services presented the Cobalt Resident Geologist's office with a Summary Report entitled "Notes and Recommendations on mineral Exploration and Mineral Data Compilation Made During G.E.D. Project Nov. 1990 to March 1991". Portions of the "Summary Report" pertaining to mineral potential in the Cobalt Resident Geologist's district are excerpted below:

Introduction

During the update of the Mineral Deposit Inventory (MDI) Geoscience Database for the Cobalt area Resident Geologist's office, the writer had a unique opportunity to review large amounts of data. The purpose of these notes is to outline highlights of the observations made during the MDI update. The notes deal in particular with information which is thought generally not to be known or published. A.W. Beecham of A.W. Beecham

Geological Services has been involved in mineral exploration and mining geology for some 25 years and most of the comments, therefore, pertain to mineral exploration. However, a few deal with the general geological and mineral data base.

Unfortunately, most of the exploration situations noted are for silver and cobalt, and due to either the current, low silver price, or the fact that the land is within the Native Land Claim and mineral rights are presently unobtainable, do not make attractive exploration targets. However, there are areas recognized with good potential for either volcanic hosted massive sulphide (VMS) deposits or typical, Archean gold deposits.

A number of suggestions and recommendations have been made regarding mineral exploration by industry and for work by the Ministry of Northern Development and Mines. These should, of course, be interpreted in light of the current metal prices. For example, there should be reservations about either industry or government making large investments directed towards silver exploration unless there is reason to believe that silver prices will rise once again to reasonably exploitable levels (only very high grade deposits could be mined at present prices)...

The update was based on more or less a complete set of Ontario Government, (Ontario Bureau of Mines, Ontario Department of Mines and Ontario Geological Survey) data, incomplete Department of Energy, Mines and Resources (Geological Survey of Canada) data, the Cobalt area assessment files, miscellaneous reports at the Cobalt Resident Geologist's office, A.W. Beecham Geological Services' knowledge and notes on the area, and discussions with the previous Resident Geologist, L. Owsiacki and Staff Geologist, E. Basa. Some brief discussions were also held with: J. Armstrong, past manager of a number of Cobalt area mines; L. Cunningham, previous mine geologist in the Cobalt and Gowganda areas; H.Moore, independent geologist and previously mine geologist at Silverfields Mine in Cobalt and Copperfields Mine in Temagami; and B. Thorniley, Chief Geologist and Assistant Mine Manager at Agnico-Eagle Mines Ltd. in Cobalt.

The original estimate of records to be updated and created was 783, which consisted of 483 known occurrences, producers and past producers and 300 new occurrences. The final total upon completion was 497 known and only 144 new occurrences. The new occurrences had apparently been estimated, in part, from the Geological Data Inventory Folio (GDIF) reports. However, many of the occurrences in the GDIF's do not meet the minimum requirements of the GED outline (e.g. assays of 0.2% Cu, 1 g/t Au etc.) and hence were not included.

In most cases, all available sources of information were referenced. This was not done in all cases as some references site previous sources and are redundant, hence some were omitted. An attempt was made to find the original reference in each case. An exception was made in the actual Cobalt mining camp, where R. Thomson's Preliminary Reports (1960a,b,c, 1961a-e, 1962) provide a uniquely, complete, property by property description. Thomson's sources were not searched except where there was reference to assessment files.

All assessment files were at least briefly reviewed. Emphasis was placed on examining summary reports, prospecting records, assay reports, geological maps and reports, and diamond drill logs. Geophysical data were given only cursory examination...

Potential for Volcanogenic Massive Sulphide Deposits

There is significant potential for volcanogenic massive sulphide (VMS) deposits in three main areas: 1) the north Shining Tree area, including particularly Kemp, Mond and Natal townships; 2) the general Cobalt area, including Coleman, Bucke, Lorrain and Firstbrook townships; and 3) the Temagami area, including Cynthia, Chambers, Strathy, Cassels and Strathcona townships. As noted below in "Notes by Township", interesting situations exist in Kemp and Mond townships in the north Shining Tree area, and in Cynthia, Chambers and Cassels townships at Temagami. Other areas of possible base metal potential are felsic volcanic rocks on the east side of the Gowganda silver area in Nicol Township and to the southeast of the Silver Centre camp in South Lorrain Township.

Further work on rare earth element (REE), and major element geochemistry as described by Fyon and Cole (1989) for the Temagami area, and Lesher et al. (1986), could be very useful in "zeroing in on" small areas of volcanic belts favourable for VMS deposits. In particular, the Shining Tree area and the Cobalt area warrant more study. Work in the Cobalt area should include putting the data collected for the OGS by G. Patterson in the late 1970's in a form readily available to the public (*see* Born 1990). The southeast Bucke-northwest Lorrain townships part of the Cobalt camp warrants some attention if not already adequately covered by Patterson. Here, small bodies of quartz-feldspar phyric subvolcanic intrusives and probably volcanic rocks occur at the Silverside deposit, probably at the Harrison-Hibbart deposit and at the Hunter Occurrence. These may, perhaps, be the only 'true rhyolites' known in the camp. The significance of the 'true rhyolites' (quartz latites), as discussed by Gibson et al. (1983) in the Noranda camp, is that they have limited distribution and may be a much more specific guide to VMS deposits than felsic volcanic rocks in general.

It is suggested that bedrock geochemistry done by the Ministry of Northern Development and Mines be of a reconnaissance nature, aimed at recognizing favourable geochemical-geological environments. More detailed work aimed at locating alteration haloes (such as sodium depletion) should be undertaken by the property holders and other mining organizations.

Silver Areas and Potential

The productive cobalt-silver areas are all underlain by mafic volcanic rocks. When looked at regionally, there is an association of the productive areas more specifically with the margins of certain felsic plutons. This is apparent at Gowganda, in the Cobalt-Silver Centre camp, where regionally, deposits and showings occur all along the south, west and northwest margins of the Lorrain granite and in the area northeast of Temagami along the margin of the Best-Strathy stock. If one accepts that the silver is derived from the Archean volcanic rocks, this observation suggests that there was a pre-concentration of metals in the volcanic rocks and interflow sedimentary rocks around these plutons.

The productive silver areas form relatively small cores within the mineralized areas. It is, hence, very important in ground acquisition to recognize this core of the system.

The main camps occur with discrete, generally small, diabase basins or domes. Regionally, silver is just as common at the upper contact of a Nipissing diabase sheet as it is at the lower contact. It is just that the large production, that from the main part of the Cobalt camp, is from the lower diabase contact.

MINERAL ZONING

There is an impression that some subtle mineral zoning occurs within the various cobalt-silver camps. Specular hematite seems to be peripheral to the main productive areas. At Cobalt, it appears that pyrrhotite (here in roots of veins) becomes more prevalent within the productive core of the camp. It is noted that specularite is abundant in the Elk Lake camp which had little production. One could speculate that the main part of the camp has not been discovered and could lie to the south where the basement rocks are more likely to be mafic volcanic rocks.

'BLIND' SILVER-COBALT DEPOSITS

The cobalt-arsenic (Co-As), in general, extend only a short distance above the productive silver zone, and if, for example, the erosional level at Cobalt was 100 m or 200 m higher, the whole camp might have gone undiscovered. It follows that other mineralized areas probably exist deeper within the basin (Cobalt Embayment). Donovan, Charters and Leith townships may represent one such area. The presence of some mafic volcanic basement in Donovan is a favourable point to start exploration in the area. Another possible setting is the Maple Mountain area in Whitson, Van Nostrand and Speight townships.

In this regard, a compilation of favourable silver-cobalt sites would be helpful as the favourability of the settings is not immediately obvious from geological maps. It is also necessary to have three-dimensional information which can only be derived from drilling and underground data and drawing at least a few sections.

Shining Tree Gold Camp

There are many gold showings but, with the exception of the Tyranite gold mine, no viable ore bodies have been found. Much of the camp lies at or just below the Huronian-Archean unconformity and the associated Nipissing diabase sheet(s). It is possible that some of the mineralization is due to hydrothermal systems driven by the Nipissing diabase. There are numerous cases of diabase-related gold elsewhere in the Cobalt Embayment, (in Ingram Township, peripheral to the Cobalt camp, at Temagami, Fabre Township, Quebec, Davies-Scadding-McClennan townships) few of which have proven to be of much economic significance.

It is possible that some of the major structures, such as the Gosselin vein, might respond to deep drilling (i.e. ore shoots may exist in some of these structures, but not at the present erosion surface).

Nowhere in the assessment files has it been noted that samples have been assayed for metallics. If there is a strong nugget effect, screening and assaying metallics separately might produce less erratic and possibly better average assays. Recently, some enhancement of gold grades have also been found by doing cyanide leach analyses. This technique could also be tried on some of the better occurrences.

The area northwest of the Tyranite gold mine, in Knight Township, appears to have excellent gold potential as noted below.

Fossil Placer Gold

Some weak indications of fossil placer gold are recorded on the west side of the Cobalt Embayment, in North Williams and Ogilvie townships. Besides the OGS work, at least B.H.P. Utah Mines Ltd., Amoco Canada Petroleum Co. Ltd. and probably Patino Mines (Quebec) Ltd. and several other firms searched the embayment for this type of deposit. The extent of their programmes and the level of their expertise is, however, not known. Either the results of this initial work were negative, or positive results could not be followed up for other reasons including the land being tied up in the Native Land Claim.

Notes by Township

ANTOINE

In the northwest part of the township, geochemically anomalous gold levels, up to 0.41 g/t Au, were found in a ± 100 m wide, pyritic, schistose quartzite. This may or may not be up-ice from the gold found in till along Hwy 533 in Mattawan Township 16 km to the southeast. The gold occurrence is within the same general area as kyanite and copper occurrences described in Butler Township.

BEST

The occurrence MDI #N 0104 (Mineral Deposits Inventory Geoscience Database number), "Cuniptau" at Granite Lake is a wide silicified zone at the southwest margin of the Best-Strathy pluton. Except for the fact that it lies too close to the Ontario Northland railway to exploit, it might be suitable for smelter flux. It is, however, likely that there are other, similar occurrences in the area. An adjacent shear zone, MDI #N 0102, "Danlou", at one point carries up to 6.2 g/t Au and 200 g/t Ag over 0.46 m. If sufficient tonnage of flux material at even 1 g/t Au could be outlined, it might be feasible to ship it by rail to a smelter. It appears the occurrence has not been examined recently for low-grade flux.

The James Lake pyrite deposit, judging from the amount of data in the public record, appears to warrant more exploration. It could very well mark the barren part of a VMS base metal deposit. In particular, compilation of the copper and zinc assays on a longitudinal projection might indicate trends worth testing with more drilling.

BUCKE

Concentrations of base metals north and northwest of Sasiginaga Lake from work by St. Joseph's Explorations and Armsher Resources are similar to the better-known occurrences on the Drummond claim east of Kerr Lake. As this is a characteristic of silver-producing areas, more exploration for silver-cobalt veins may be warranted, particularly around Lot 5, Concession II, where the Nipissing diabase was not too far above the present erosional surface.

BURROWS

In the southeast part of the township, a 165° trending band of carbonatized komatiites carry low gold values of up to 3.8 g/t Au (*see* MDI #S 2912). Very little exploration has been done here.

In the southwest part of the township, a float occurrence consisting of quartz veins in mafic volcanic rocks with high-grade gold has received considerable attention, particularly from Newmont Explorations. Just north of the float, there is a tight fold in iron formation and ultra mafic rocks, hence the possibility of a Homestake-Echo Bay type gold setting exists. No up-ice source for the float has been found. However, Argentex recently found gold values in the bedrock down-ice from the float (*see* MDI #S 2911). This area is very intriguing, in spite of the amount of detailed work by Newmont.

The best available geological map of Burrows Township, is one at approximately 1:50 000 by Newmont, a copy of which is in the assessment files.

BUTLER

Here, disseminated chalcocite-chalcopyrite in quartz veins cut calc-silicate and rusty weathering quartz-muscovite ± kyanite gneiss. Although the veins themselves may not be of much importance, the possibility that the copper has been remobilized from a metasediment-hosted copper deposit should be checked. Some very important copper ± lead-zinc deposits are hosted by Proterozoic sedimentary rocks. Prospecting and regional geochemistry would be the recommended approach to test this possibility.

CASSELS

An area favourable for silver-cobalt-arsenic veins exists between Pishabo Lake and the north arm of Cassels Lake, where basement rocks are mineralized and are overlain by the Coleman Formation sedimentary rocks and they in turn by Nipissing diabase. Limited exploration has been done here. The Silver Leader occurrence, (MDI #N 0106) at Bogie Lake, has chalcopyrite in Coleman member rocks, but no veins have been found.

CHAMBERS

Archie Lake showing (Bennet 1978, property "3", in the western part of the township) is possibly a low-grade VMS occurrence and should be examined in light of Fyon and Cole's (1989) work. Quite a bit of chlorite alteration is reported with the sulphides. Very little exploration work is recorded in this area, and that done to date appears to have been for precious metals.

COLEMAN

There are a number of interesting exploration situations in Coleman Township. However, these are generally well-known and will not be discussed here. One little-known area of interest is in the west part of the township in Lots 11 and 12, Concessions III and IV. Here, southwest of the abandoned airfield and the old Mohawk Shaft, there is a favourable silver-cobalt setting where mafic volcanic basement is overlain by Coleman member sedimentary rock which in turn are overlain by Nipissing diabase. This area was partly tested by Sherritt-Gordon Limited, but there is a large untested area below a depth of 1000 feet.

CONNAUGHT

A copper-iron skarn in Huronian, Espanola Formation limestone at Elephant Head Lake should be examined for tungsten and gold. Skarn development in the Espanola Formation would likely be due to late felsic intrusive rocks, as opposed to the emplacement of the Nipissing diabase.

Elsewhere in Connaught Township, a number of copper occurrences, such as "Active", "Picket Lake" and "Coniston" may be related to Nipissing diabase and, as such, would not be as interesting as if the mineralization was related to the enclosing volcanic rocks.

CYNTHIA

At Ferrim Lake (MDI #N 0175), minor zinc (best assay: 1.86% Zn over 0.37 m) and Cu (best assay: 0.16% Cu over 0.82 m) occur in a 5 to 20% pyrite zone. The zone is within calc-alkalic, dacite pyroclastic breccias suggestive of a favourable VMS horizon. Some chalcopyrite-bearing float occurs on the shore of Ferrim Lake south of the apparent horizon. As described for Chambers Township above, this is within Fyon and Cole's (1989) belt of favourable volcanic rocks.

JOAN

The Hanover showings consist of carbonate-chalcopyrite veins in Nipissing diabase. They are underlain by up to 60 m of Gowganda Formation and then by 'Keewatin' mafic volcanic rocks. There may be some unrecognized potential here for silver-cobalt veins.

At the northeast tip of Temagami Island, blebs of chalcopyrite up to 45 cm in diameter occur in sericitized rhyolite. This suggests a VMS setting similar to Copperfields Mining Corporation's Temagami mine. However, the area has most likely been well examined by Copperfields Mining Corp.

KEMP

A hole diamond drilled by Hudson Bay Oil and Gas cut significant concentrations of pyrite in felsic pyroclastic rocks (MDI #S 2903). The drill intersection consists of a 53 m section of 30 to 40% pyrite including 14 m of massive pyrite. The whole sulphide zone is about 850 m long. Although the best base metal concentration reported is only 0.01 to 0.1% Zn (semi-quantitative analyses) over 6.8 m, in this setting it could mark a barren portion of a typical VMS base metal deposit.

KNIGHT

The structure and lithology which hosts the Tyranite gold deposit in northern Tyrrell Township appears to continue northwestward for a number of kilometres into Knight Township. Particularly favourable settings for gold would be expected at the contacts of the granitoid stock with ultramafic rocks and basalt-ultramafic contacts northwest of the Tyranite deposit.

LORRAIN

Compilation of assessment data and a few cross sections in the area south of the Silversides deposit would indicate if there is more exploration potential in the Huronian valley in this area.

The minor copper and silver occurrences in Lot 1, Concession XII could be upper parts of productive silver veins, or alternatively, simply mark peripheral "noise" to the Silversides deposit.

LUNDY

Four new occurrences are recorded from recent mapping. A minor silver find in the southwest part of the township was made by Silverside Resources and in the central to northeast part, cobalt, copper, zinc, lead and minor silver values occur. The depth to Keewatin volcanic rocks is, however, uncertain (although Owsiacki (1986) states that it is only 150 m in the east part of the township) and therefore the silver potential is uncertain.

In the southeast part of the township, chalcopyrite veins could be related to silver veins, but it is not known if they might represent the tops or roots of such veins.

MOND

North of Ferris Lake and just east of the power line, Grange's 1977 diamond drilling (Cobalt Assessment file "Granges Exploration (Canada) AB, DH HUT-58) intersected about 6 m of heavy to massive pyrite in rhyolite and rhyolite breccia, as well as some talcy, soft material that could be komatiite or strong chlorite alteration. This area warrants considerable more attention for VMS deposits.

NICOL, HAULTAIN AND VAN HISE

An ultramafic horizon (mapped as peridotite in Van Hise Township) can be traced from the northwest to southeast across most of the Gowganda camp. Although the ultramafic units themselves are of no particular significance, the unit does provide an obvious subdivision to the Keewatin and further study might help to rationalize the distribution of silver-cobalt veins. In the Cobalt camp, silver-cobalt veins, whether actually hosted by Huronian sedimentary rocks, Nipissing diabase or Keewatin volcanic rocks, seem to coincide with areas where the Keewatin rocks are basalts with numerous cherty-graphitic, sulphide-rich interflow sediments. Areas of felsic volcanic or sedimentary Keewatin rocks are unproductive for silver-cobalt. The fact that the Keewatin rocks around the Leroy shaft in eastern Nicol Township are mainly felsic volcanic rocks could explain why the east side of the Gowganda diabase basin has been unproductive.

NORTH WILLIAMS

There is some indication of a weak fossil placer gold environment here. One sample by the Ontario Geological Survey returned 1.06 g/t Au from a lower Lorrain Formation hematitic quartzite (MDI #T 1485).

OGILVIE

Here, work by BHP Utah Mines Ltd. returned an assay of 1.7 g/t Au in Lorrain Formation quartzite, suggesting a weak paleoplacer gold environment similar to that in North Williams Township (MDI #S 2922).

PARKMAN

The abundance of iron formation in this part of the Grenville Province might suggest that this is an assemblage of metamorphosed, Archean felsic volcanic rocks and iron formation similar to the near by Temagami camp. However, this is apparently not so as there are few, if any, amphiboles which one would expect in abundance from metamorphosed Archean volcanic rocks and the zircon ages of these rocks is around 1700 million years (S. Lumbers, Ontario Geological Survey, personal communication, 1991).

PENSE

Three copper ± zinc occurrences on Ontario Geological Survey Map 2205 (Timmins-Kirkland Lake Geological Compilation series) could not be found on other published maps or in the assessment files. Whether they are significant showings or not is unknown.

A belt of ultramafic rocks (peridotite and gabbros) shown on Map P.1222 (Lovell and Frey 1977) is not incorporated on the geological compilation series map. This has some relevance for gold exploration. More compilation is recommended here including information in the adjacent Quebec townships.

PHYLLIS

An interesting float occurrence on a point on the west shore of the southwest arm of Lake Temagami, just northwest of Island 574 (Ontario Department of Mines Map 2057, Simong 1964), is not recorded in published literature. The float consists of large, glassy, quartz vein fragments with pyrite, cobalt bloom, chalcopyrite and possibly tetrahedrite. Assays of grab samples report up to 10.7% Cu, $3.95 of Au (ca.1953) and 0.17% Co. The float is thought to be close to its source.

SOUTH LORRAIN (SILVER CENTRE)

As with the Cobalt camp, the productive area is very small compared to the area of showings.

Even though quite a bit of work has already been done, it appears (with the brief review made) that there is potential to the west, (down dip) of the main productive area. It would require a brief compilation, a plan view and a few east-west sections to get a better appreciation of the area's potential which may be considered to be mainly below 1000 feet.

In the area southwest of Maiden's Bay, there is a large area with a Keewatin-Huronian-Nipissing succession. Very little drilling has been done here and there is reasonable potential for silver-cobalt veins.

There appears to be reasonably good potential for locating more veins under Trout (Tooth) Lake and extending the productive part of the camp southwards.

STRATHY

Regionally, there is a cluster of gold, silver, arsenic, copper and even nickel-platinum group element showings around the southwest margin of the Strathy-Best Quartz Monzonite stock. These occurrences probably extend eastward under the Huronian cover into Cassels Township, suggesting a possible site for silver-cobalt veins.

WHITSON, VAN NOSTRAND AND SPEIGHT

The silver-cobalt showings in this area could easily represent the tops of deep vein systems. The area could be explored by deep, pulse-type EM in an attempt to locate conductive sulphide and graphite-rich interflow sediments, followed by deep diamond drilling to test any targets thus found.

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16. Sudbury Resident Geologist's District—1991

M. Cosec[1] and B.I. Gates[2]

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INTRODUCTION

Mining, development, and exploration activities remained relatively stable in 1991, despite depressed metal prices, a strong Canadian dollar, and general recessionary effects. A total of 17 underground and open pit mines were in operation, producing 10 commodities. Production was suspended at 4 low-grade operations late in the year.

Mine development continued at the Lower Coleman and McCreedy East orebodies, but was suspended at the latter in September. The Frood-Stobie Mill was decommissioned and all milling operations have been consolidated at the Clarabelle Mill.

Falconbridge Limited continued mine development at the Craig and Strathcona mines as well as underground exploration at the Thayer Lindsley deposit.

Surface exploration by the major mining companies was concentrated on patented holdings within the Sudbury Basin for nickel, copper, and precious metals. Inco Limited achieved favourable results from diamond drilling at the McCreedy East and Victor nickel-copper properties. Falconbridge Limited continued with exploration of the Wanapitei (Temagami) Magnetic Anomaly on their Mirage project. Prospecting activity and exploration by individuals increased, due in part to the Ontario Prospectors Assistance Program (OPAP) and the Ontario Mineral Incentives Program (OMIP). There were 31 individuals receiving a total of $296 066 through OPAP, while 7 companies and individuals received a total of $207 899 through OMIP.

Interest in dimension stone was high, and potential developers from across Canada, Italy, Great Britain, and the Sudbury area examined various granites and Espanola Formation limestone.

Cameco Corporation opened a district office in Sudbury in 1991, in an effort to diversify and expand its operations in eastern Canada.

Sudbury has been chosen as the site for the International Conference on Large Meteorite Impacts and Planetary Evolution, scheduled to take place August 31 to September 2, 1992. The conference is sponsored by the Ontario Geological Survey, the Lunar and Planetary Institute, and the International Union of Geological Sciences Commission on Comparative Planetology.

Both Inco and Falconbridge maintained their long-term commitment to pollution abatement and revegetation with smelter upgrading programs as well as manual and aerial reseeding.

MINING ACTIVITY

The production of nickel, copper, and precious metals by Inco Limited and Falconbridge Limited dominate mining activities in the area. Accurate production statistics for nickel and copper are unavailable. Production from all area mines in 1991 is approximately 320 million pounds of nickel and 300 million pounds of copper. The Sudbury area mines annually produce approximately 150 000 ounces of by-product platinum, thus affording Sudbury the distinction of being the world's third largest platinum producer.

Commodity prices fell modestly from 1990 averages. The average price of nickel for 1991 (at the time of writing) was US$3.77 per pound compared to an average of US$4.03 per pound in 1990. The yearly high was US$4.22, while toward the end of the year, the price fell below US$3.30 per pound. Copper averaged US$1.03 per pound in 1991, compared to US$1.21 per pound in 1990. Gold averaged US$362.59 per ounce in 1991, down from US$383.72 per ounce in 1990.

The year 1991 marked the 90th anniversary of mining at Inco's Creighton Mine complex. Originally discovered in 1855, the first ore was not hoisted until 1901. Since then, 160 million tons of ore have produced 4.8 billion pounds of nickel. The mine's deepest current production horizon is 7200 feet below surface.

At Inco's Copper Cliff Smelter, the first of two new oxygen flash furnaces was commissioned by His Royal Highness The Prince of Wales in October. Additional changes and modifications will result in the containment of 90% of sulphur emissions from the smelting of Sudbury ores by 1994. The SO_2 abatement project is now 85% completed.

Inco Limited

Inco Limited operated 9 underground mines, 2 open pits, 2 mills, 1 smelter, 2 refineries, 3 sulphuric acid plants, 1 liquid sulphur dioxide plant, and one strip rolling mill (Figure 16.1). The Frood-Stobie Mill has been decommissioned, while concentrate dewatering continues at the Copper Cliff Mill. The Clarabelle Mill has been upgraded and now has a throughput capacity of 45 000 to 50 000 tons per day.

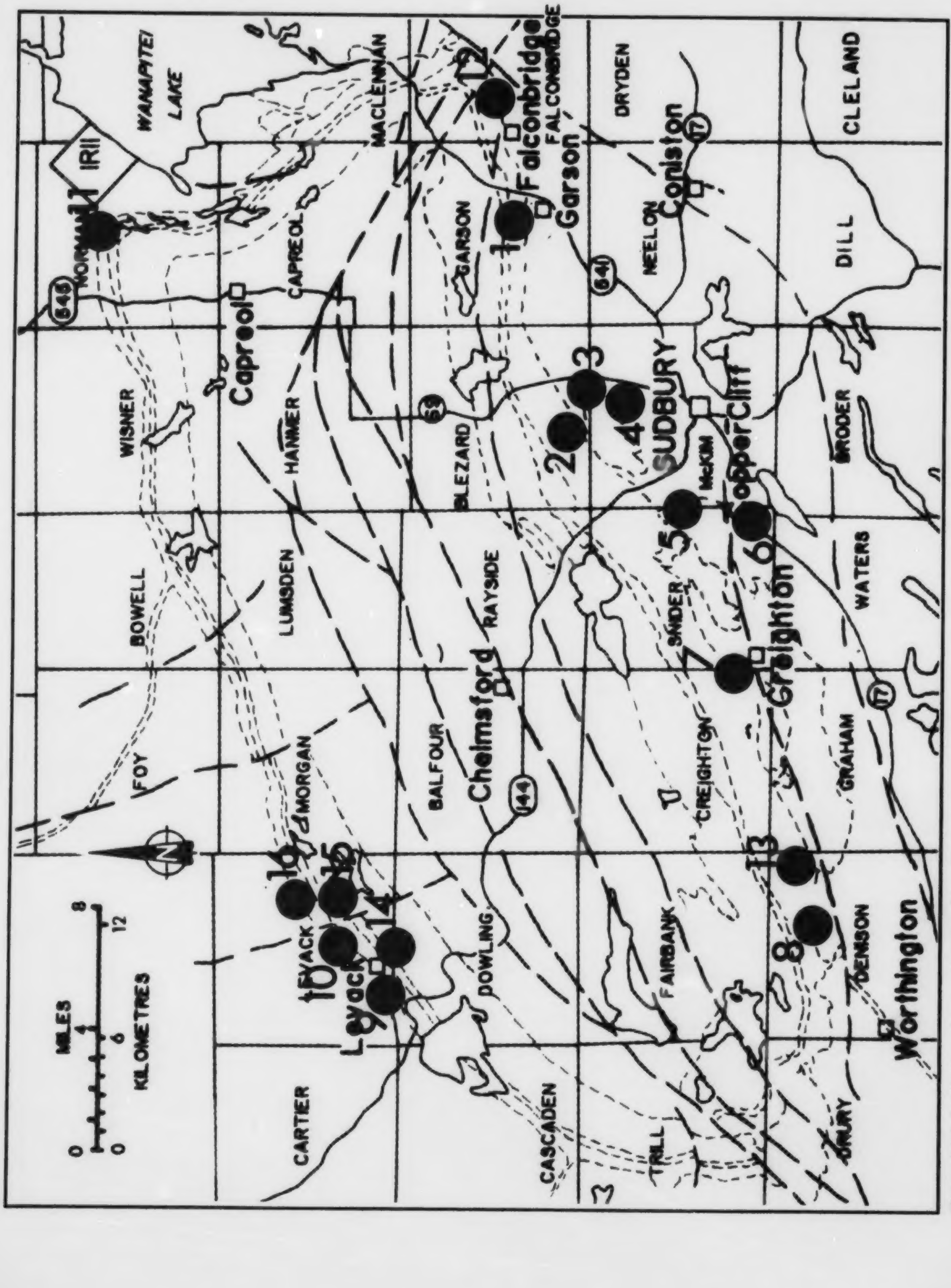
MILES
0
4
8
KILOMETRES
0
6
12
N
WANAPITEI LAKE
IRII
CARTIER
CASCADEN
TRILL
DRURY
FOY
MORGAN
LEVACK
DOWLING
FAIRBANK
DENISON
GRAHAM
CREIGHTON
BALFOUR
BOWELL
LUMSDEN
RAYSIDE
SNIDER
WATERS
WISNER
HANMER
BLEZARD
McKIM
BRODER
CAPREOL
GARSON
NEELON
DILL
MACLENNAN
FALCONBRIDGE
DRYDEN
CLELAND
Levack
Chelmsford
Creighton
Copper Cliff
SUDBURY
Capreol
Garson
Falconbridge
Coniston
Worthington
545
144
69
541
17
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

Figure 16.1. Producing mines and commodities, Sudbury.

LEGEND

Cobalt Resident Geologist's District

● Producing Mines, 1991

INCO LIMITED
Ni, Cu, Co, Au, Ag, PGM, Se, Te, SO_2, H_2SO_4

1 Garson Mine and Open Pit
2 Little Stobie
3 Stobie
4 Frood
5 Copper Cliff North
6 Copper Cliff South
7 Creighton
8 Crean Hill
9 McCreedy West
10 Levack
11 Whistle Open Pit

FALCONBRIDGE LIMITED
Ni, Cu, Co, Au, Ag, PGM, H_2SO_4

12 Falconbridge Open Pit, No. 5 Shaft
13 Lockerby
14 Onaping
15 Fraser
16 Strathcona

Low nickel prices toward the end of the year resulted in the suspension of mining at three low-grade operations. These include the Creighton No.3 Mine, Garson open pit, and Whistle open pit (mined by MacIssac Mining and Tunnelling Company).

Inco Limited reported earnings of US$82.6 million for 1991, compared with US$441.2 million for the previous year. Production from the Sudbury area operations totalled 244.8 million pounds of nickel and 228.6 million pounds of copper.

Operations were halted for a five-week period in July and August for the annual vacation and maintenance shutdown.

Falconbridge Limited

During 1991, Falconbridge produced from 5 underground mines and 1 open pit (*see* Figure 16.1). Processing plants include 1 smelter, 1 sulphuric plant, and the Strathcona Mill, capacity rated at 10000 tonnes per day.

The drop in nickel prices resulted in the suspension of crown pillar mining at the Falconbridge Mine. In addition to the suspension of all mining operations for the annual two-week vacation period in July, lower nickel prices caused the company to suspend mining operations for another two-week period in December and a five-week shutdown has been announced for 1992.

Falconbridge Limited reported earnings of $21 million for 1991, compared to $91 million for 1990. The company produced approximately 75 million pounds of nickel and 75 million pounds of copper in 1991, compared to 70 million pounds of nickel and 65 million pounds of copper in 1990.

Industrial Minerals

Unimin Canada Limited operates the Badgely Island high-grade silica quarry, 4 km west of the village of Killarney, with production estimated at 430000 tons. The coarse silica is shipped to Midland, Ontario and Ashtabula, Ohio for further processing into silica sand for the glass industry.

Standard Aggregates Incorporated operated its Meldrum Bay Quarry at the west end of Manitoulin Island during the Great Lakes shipping season. The company produces high-grade dolomite from a 50 foot face in the Silurian Amabel Formation. Production is estimated at 2.4 million tons per year with total reserves of 100 million tons.

Carman Construction Incorporated produced 120 000 tons of silica from a quarry they operate on a seasonal basis near Alban. The material is used as smelter flux for the Inco Limited Copper Cliff Smelter. Carman Construction also operated a small silica quarry near Lake Panache in Roosevelt Township, the material from which is sold as exposed aggregate by custom order only.

Table 16.1. Summary of claims recorded and assessment work credit.

Year	Claims Recorded	Claims Cancelled	Claims Active	Diamond Drilling (Man Days)	Geophysical Surveys (Man Days)	Geological Surveys (Man Days)	Total (Man Days)	Geotechnical Survey (Dollars)	Physical Survey (Dollars)
*1991	1237 137 blocks	2179	6158	34 691	80 168	1960	116 819	44 750.02	67 600.12
1990	2576	2068	7458	14 309	32 560	2537	87 709		
1989	761	1615	6510	25 255	49 743	8862	104 052		
1988	893	1780	7321	21 303	255 824	8 746	304 792		
1987	5777	720	9358	16 266	43 721	3467	77 041		

*with the new Mining Act in effect June, 1991, assessment work requirements changed to dollar value

Crea-Mac Contracting Company Limited operated a small, pink-feldspar quarrying and crushing operation near Warren. The material is used for decorative aggregate with production on an "as required" basis.

Hercules Stone Limited extracted approximately 500 tons of Silurian Manitoulin Formation limestone from the Foxey Quarry in Gordon Township on Manitoulin Island. The rock is used for curbing and landscaping.

C. Larcher, owner of the former Dana Black Granite Quarry near River Valley, sold several stockpiled, lower quality, black granite blocks to Allstone Quarry Products Limited of Schomberg, Ontario, and to St. Mary's Ukrainian Greek-Catholic Church for landscaping at the Junction Creek beautification project in Sudbury. A large quantity of low-grade blocks remain at the quarry.

Considerable quantities of sand and gravel are also extracted by numerous companies throughout the Sudbury district.

Advanced Exploration

Underground exploration and development were conducted at most producing mines in the Sudbury Basin throughout the year. Development properties of notable interest are mentioned below.

Near the Inco Limited McCreedy East Mine, 7.5 million tons of ore grading 7.27% Cu, 1.04% Ni, and 0.23 ounce precious metals per ton were delineated at a vertical depth of 4500 feet. This new zone has increased total mine reserves to 32.5 million tons grading 2.27% Cu, 1.58% Ni, and 0.071 ounce precious metals per ton (*The Northern Miner*, November 25, 1991, p.2). Inco Limited plans to spend $179 million to bring this property into production by 1996. Annual production should total 40 million pounds nickel and 20 million pounds copper mined at a rate of 7000 tons of ore per day. Development also continued at the Lower Coleman Mine.

Falconbridge Limited completed shaft-sinking at its Thayer-Lindsley nickel-copper deposit to 1638 m. Drifting to establish drill stations, and the subsequent drilling, took place on the 1310 m level and 1585 m level. The company also continued work on its $280 million project to develop the Craig orebody in the Onaping-Levack area. Work is scheduled for completion in 1993 and the mine is expected to produce 45 million pounds of nickel annually, or approximately 60% of Falconbridge's nickel production in the Sudbury area. Development work includes drifting from the Strathcona Mine to access the orebody. Work of a similar nature continued at the Strathcona Mine to access a deep, high-grade copper zone.

EXPLORATION ACTIVITIES

The Sudbury Resident Geologist's District encompasses 27 500 km^2 (Figure 16.2). Geologically, the area is underlain by rocks of Archean, Proterozoic, and Palaeozoic age.

The area is famous for its large, world-class, copper-nickel-precious-metal mines associated with the Sudbury Igneous Complex and, to a lesser extent, for its many precious-and base metal occurrences outside the Sudbury Igneous Complex.

Exploration activity by major mining companies outside of the Sudbury Basin declined slightly from 1990. Most programs in the Benny greenstone belt were terminated or postponed, despite the release of the airborne electromagnetic survey by the Ontario Geological Survey for that area. However, overall prospecting activity realized a modest increase in the number of individuals engaged in grass-roots exploration such as stripping and trenching. This was particularly true for the commodities of silica, garnet, and dimension stone.

Several exploration projects are highlighted as follows (the size of a mining claim mentioned in this report is defined as a 40 acre unit).

A. Barry

A. Barry completed stripping and trenching on a four claim group in Baldwin Township. Copper, nickel, and anomalous gold mineralization was encountered in a zone 10 by 5 m hosted in Nipissing diabase. Mr. Barry indicated the strike length of the mineralized zone may extend to over 500 m.

H. Barry

H. Barry conducted stripping, trenching, and lithogeochemical sampling for zinc mineralization on a seven-claim group in Hutton Township. The survey area is at the contact of Archean granites and Archean metavolcanic rocks.

R. Barry

Prospecting by R. Barry was successful in locating blebby, chalcopyrite- and pyrrhotite-bearing footwall gneiss (Levack Gneiss) in surface outcrop, in Wisner Township, on the North Range of the Sudbury Igneous Complex.

Bharti Laamenen Mining Limited

Bharti Laamenen Mining Limited continued their long-term exploration programs on several base metal properties in the Benny greenstone belt.

Soil and lithogeochemical surveys, along with various geophysical surveys, were completed on pyritiferous veins within granite in Cartier Township.

In Hess Township, minor stripping and trenching were done on the "Lynx" or "Central Hess" showing. This Precambrian skarn deposit is known to host silver, lead, zinc, and copper mineralization. No mineralization was encountered outside of the main zone, and further exploration has been recommended to locate the intrusive contact beneath overburden.

Trenching and lithogeochemistry were completed on the "T. Holstrom" precious metals occurrence in Rhodes Township. The geology is described in the "Property Examinations" section of this report.

P. Blue

P. Blue completed trenching and till geochemical sampling on a single claim in Hutton Township. The area is covered by thick sand and gravel dissected by the Roberts River, a tributary of the Vermillion River, and known to contain minor amounts of placer gold. The current exploration yielded poor results, with assays of less than 0.01 ounce Au per ton.

P. Blue also conducted trenching and lithogeochemical sampling on a single claim in western Caen Township. This property is underlain by Huronian Supergroup metasedimentary rocks intruded by Nipissing diabase and hosts a number of small copper-nickel occurrences. A number of quartz veins are also in the area, and have been targeted for smelter flux.

J.D. Bradley

J.D. Bradley completed ground electromagnetic and magnetometer geophysical surveys on his claim groups in Aylmer and Rathbun townships. Most of the properties are underlain by Lorrain Formation and Gowganda Formation metasedimentary rocks hosting small lenses of chalcopyrite and specular hematite.

J. Brady

J. Brady conducted stripping and trenching on his "Harama" marble deposit in Parkin Township throughout 1991. The unit of economic importance on the property is Espanola Formation limestone of the Huronian Supergroup. Intercalated with minor thin beds of siltstone, the rock has alternating beds of green, buff, and pink carbonate. This attractive rock may be suitable as a dimension stone if large blocks without flaws can be extracted. The potential reserves have been estimated at 1.2 million tonnes, and marketing of the product is currently underway. Field work consisting of stripping and test-block extraction is expected to continue in 1992 (Sudbury Resident Geologist's files).

J. Brady also completed stripping, trenching, and lithogeochemical sampling on a gold-silver-copper prospect in Fraleck Township.

D. Brunne

Platinum group metals were the targeted commodities sought by D. Brunne in Shibananing Township. Stripping and trenching were completed on altered metagabbros and amphibolites of the East Bull Lake layered intrusive complex.

In a related program, the basal unit of the Shakespeare-Dunlop layered anorthositic-gabbro intrusion in Shakespeare Township was evaluated for use as a decorative stone. The unit is a glomeroporphyritic gabbro with extremely coarse-grained plagioclase phenocrysts.

D. Brunne, along with M. Turcott, initiated a small stripping, trenching, and lithogeochemical sampling program on a poorly defined copper skarn in Porter Township. Further exploration on this property will continue in 1992.

F. Carpino

A local monument manufacturer, F. Carpino, continued his investigations of dimension stone potential in Goschen Township. The rocks on the property appear to be fine-grained Nipissing diabase and recrystallized Huronian Supergroup metasedimentary units.

E.C. Charters and R. Rousseau

E.C. Charters and R. Rousseau staked an 840 acre claim group in northwest Beulah Township in 1991. The property includes the "Beulah Township Placer No.1" gold occurrence that was the subject of sluicing operations in 1900 by the Onaping Mining Company of Ontario. The gold is confined to sands and gravels in the paleochannels of the ancient Vermillion River which flowed across the area during the Pleistocene Epoch. Production history is sketchy, but a nugget weighing 2 ounces is reported to have been discovered locally. Several exploration companies have examined the placer gold potential in the area using a variety of methods up to the mid-1980's, but few encouraging results have been reported or submitted for assessment credit (Sudbury Resident Geologist's files).

Falconbridge Limited

Falconbridge Limited conducted exploration on several projects in the Sudbury area in 1991. Much of this work was done on patented and leased land, thus, detailed information is considered proprietary.

Within the Sudbury Basin, Falconbridge conducted stripping, trenching, soil and lithogeochemical surveys, ground geophysical surveys, geological mapping, and diamond drilling in 16 townships.

Falconbridge continued similar exploration on the Errington and Vermillion lead-zinc-copper properties, also located in the Sudbury Basin. The origin of the ore is considered to be sedimentary exhalative and hosted in the Vermillion Member of the Onwatin Formation. The project is subject to a joint venture agreement with Royal Oak Resources Limited (formerly Giant Yellowknife Mines Limited), where in Falconbridge can earn a 51 percent interest. Drilling is expected to continue throughout the winter of 1991–92.

In the Benny greenstone belt, Falconbridge conducted stripping, trenching, geological mapping, diamond drilling, and lithogeochemical sampling on their claims in Moncreiff, Hess, Munster, Ulster, and Stralak townships. The property is underlain by Archean mafic to felsic metavolcanic and metasedimentary rocks. Two diamond drill holes totalling 870 m failed to intersect any significant mineralization and the best assay values in the core recorded 0.54% Zn and 0.16% Pb over 1.65 m. This large claim group lies between the Stralak lead-zinc occurrence and the former Geneva Lake lead-zinc mine (Sudbury Resident Geologist's assessment files). No further exploration is planned.

In Hess Township, a 150 m diamond-drill hole was completed to test a surface electromagnetic conductor on the "Voyageur" base and precious metals property. A zone of up to 20% pyrite and pyrrhotite was intersected over 0.5 m, but failed to yield significant assay values.

In Rhodes Township, approximately 8 km northwest of the Benny greenstone belt, Falconbridge completed airborne magnetometer and electromagnetic geophysical surveys. A total of eight conductive trends were encountered in Archean metavolcanic and metasedimentary rocks, four of which have been recommended for follow-up exploration.

On their "Mirage" project, Falconbridge completed airborne magnetometer and electromagnetic geophysical surveys, seismic geophysical surveys, geological mapping, and lithogeochemical sampling in eight townships. The property consists of over 1500 claims and covers the western end of the Wanapitei (Temagami) Magnetic Anomaly. In late August diamond-drilling commenced on a vertical hole in northeast Sheppard Township. The collar location was reportly based on airborne geophysics and seismic reflection data which suggested the Huronian Supergroup–Archean unconformity to be approximately 1000 m below surface. Drilling was completed in early November of 1991. The hole failed to reach the unconformity and was stopped in Huronian Supergroup conglomerate (Gowganda Formation or Serpent Formation) at a depth of approximately 2190 m. A downhole electromagnetic geophysical survey was completed in winter and drilling is expecting to resume in early 1992 (*The Northern Miner*, November 4, 1991, p.12).

Flag Resources (1985) Limited

Flag Resources (1985) Limited also has significant land holdings over the western end of the Wanapitei (Temagami) Magnetic Anomaly, including part of the western peak of the magnetic expression. Recent personal communication with M.C. McLeod (President, Flag Resources (1985) Limited, 1991) indicated that the company will begin drilling anomalous base metal mineralization in altered (albitized) Lorrain Formation quartzites during the winter of 1991–92. The company may also attempt to locate the Huronian Supergroup–Archean unconformity in an attempt to better understand the nature of the magnetic anomaly.

Galo Exploration Services Incorporated

Galo Exploration Services Incorporated completed stripping, trenching, geological mapping, and lithogeochemical sampling on the Aux Sable platinum group metal-nickel-copper occurrence in Boon Township in the East Bull Lake area.

Geneva Lake Minerals Corporation

Geneva Lake Minerals Corporation completed exploration that began in late 1990 around the former Geneva Lake lead-zinc mine in Hess Township (Cosec 1991). The company completed 23 diamond drill holes totalling approximately 4800 m, followed by a program of downhole geophysics. No further results have been released by the company.

J.C. Gervais

J.C. Gervais completed ground magnetometer and VLF electromagnetic geophysical surveys, stripping, trenching, and lithogeochemical sampling on the "Gervais-Eldorado" property in Ulster Township. The two-claim group, underlain by migmatitic gneiss and granodiorite, is reported to contain two shafts developed as gold prospects. However, no detailed geology has been published from the immediate area.

R. Gervais

R. Gervais completed ground VLF electromagnetic geophysical and lithogeochemical surveys on his property located at the former Moose Mountain iron ore mine in Hutton Township. Mr. Gervais is attempting to locate zinc-sulphide mineralization that was identified as a significant zone by the previous owners, peripheral to the iron ore (R. Gervais, Prospector, personal communication, 1991). This mineralized zone is exposed on the open pit walls and is thought to occur at the

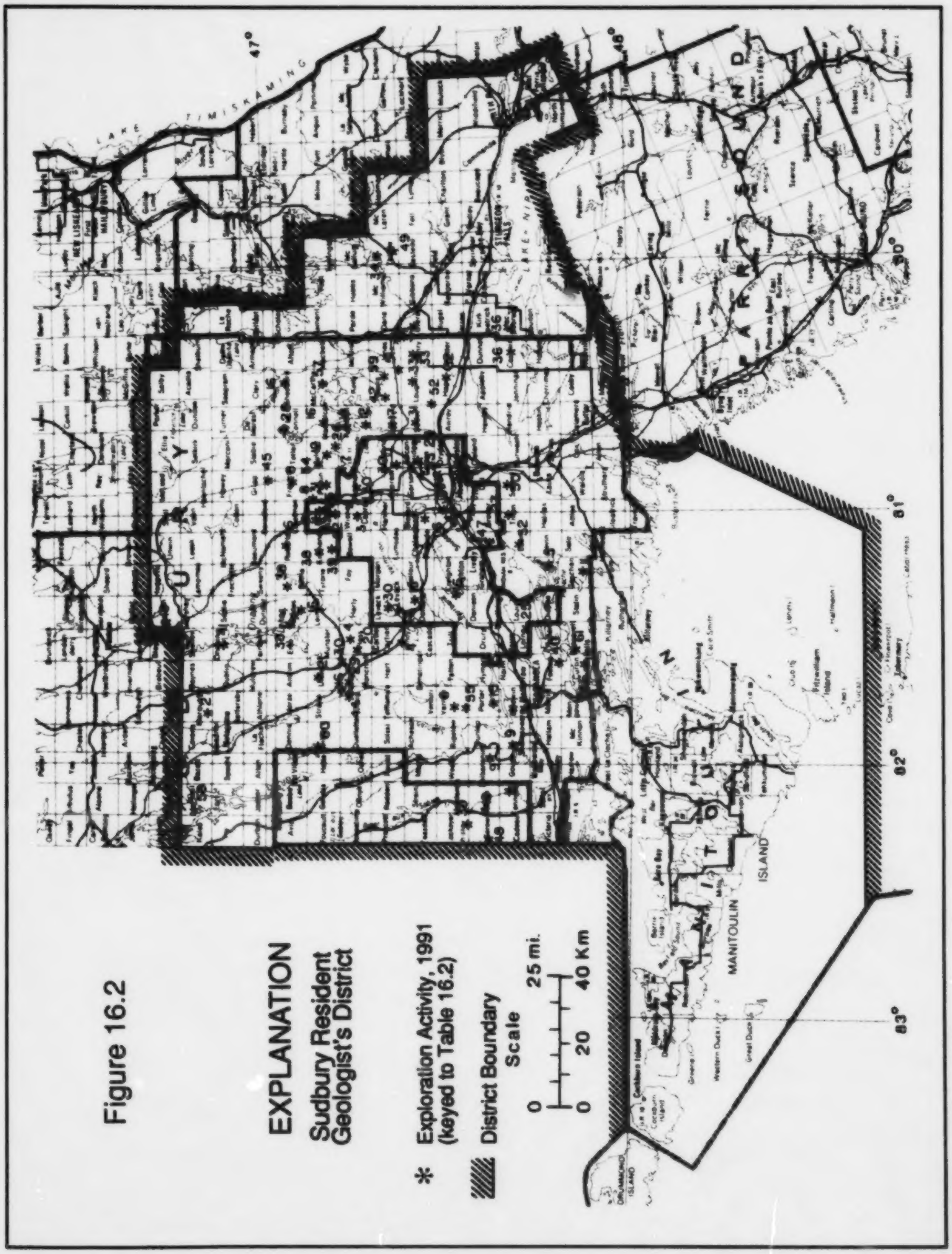
Figure 16.2
EXPLANATION
Sudbury Resident Geologist's District
* Exploration Activity, 1991 (keyed to Table 16.2)
▨ District Boundary
Scale
0 25 mi.
0 20 40 Km
LAKE TIMISKAMING
MANITOULIN ISLAND
47°
46°
81°
82°
83°
80°

Figure 16.2. Exploration activity.

Table 16.2. Exploration activities, 1991.

Abbreviations

DD .... Diamond Drilling
Geochem .... Geochemical Survey
Geophys .... Geophysical Survey
STr .... Stripping
Tr .... Trenching

Number on Figure 16.2	Individual or Company	Activity
1	Barry, A.	STr, Tr
2	Barry, H.	STr, Tr, Geochem
3	Barry, R.	Tr, Geochem
4	Bharti Laamanen Mining Incorporated	Geochem, Geophys, STr
4	Bharti Laamenen Mining Incorporated	STr, Tr
4	Bharti Laamenen Mining Incorporated	Tr, Geochem
5	Blue, P.	Tr, Geochem
5	Blue, P.	Geochem
6	Boulard, V.	Prospecting
7	Bradley, J.D.	Geophys
8	Brady, J.	STr, Tr, Geophys
8	Brady, J.	Geochem, STr, Dimension stone evaluation
9	Brunne, D.	Dimension stone evaluation
9	Brunne, D.	STr, Geochem
10	Brunne, D. and Turcott, M.	STr, Geochem
11	Carpino, F.	STr, Tr, Dimension stone evaluation
12	Charron, R.J.	STr, Tr
13	Charters, E.C. and Rousseau, R.	Placer
14	Clifton Associates Limited	Tr, Geology
15	Elliot Explorations	Prospecting
16	Falconbridge Limited	STr, Tr, Geochem, Geology, Geophys, DD
16	Falconbridge Limited	STr, Tr, Geology, DD
16	Falconbridge Limited	Airborne and ground Geophys, Geology, Geochem, DD
16	Falconbridge Limited	Airborne Geophys
16	Falconbridge Limited	STr, Tr, Geochem, Geology, DD
16	Falconbridge Limited	Underground Shaft sinking, Drifting, DD, Geochem, Geology
17	Fielding, R.	Geochem
18	Flag Resources (1985) Limited	DD
19	Galo Exploration Services Incorporated	STr, Tr, Geology, Geochem
20	Geneva Lake Minerals Corporation	DD, Geophys
21	Gervais, J.C.	Geophys, STr, Tr, Geochem
22	Gervais, R.	Geophys, Geochem, DD
23	Gilbert, M.	DD
24	Goldteck Mines Limited	Geophys, Geochem, DD
25	Gordon Salo Contracting Limited	STr, Tr, Geochem, Geology
26	Hammerlund, G.	Placer
27	Hanninen, T. and Maki, A.	Geochem
27	Hanninen, T. and Maki, A.	Tr, Geology, Geochem
28	Hinds, R.S.	STr, Tr
29	Huycke, J.G. and Nolan, P.	Geophys

Table 16.2. Continued.

Number on Figure 16.2	Individual or Company	Activity
30	Inco Exploration and Technical Services Incorporated	STr, Tr, Geochem, Geology, Geophys, DD
30	Inco Exploration and Technical Services Incorporated	Prospecting
30	Inco Exploration and Technical Services Incorporated	Underground - DD, Geology, Geochem
31	Jarvis Resources Limited	STr, Geochem, Dimension stone evaluation
31	Jarvis Resources Limited	DD
32	Komarechka, R.G.	STr, Geology, Geochem
32	Komarechka, R.G.	Geology, Geochem
33	Leblanc, A.	DD
33	Leblanc, A.	STr, Geochem, Percussion drilling
33	Leblanc, A.	STr, Tr, Geochem
34	Legarde, J.P.	Geophys
35	Maki, O.T.	Placer
36	Manex Granite Incorporated	STr, Dimension stone evaluation
36	Manex Granite Incorporated	Dimension stone evaluation
37	Midas Minerals Incorporated	Geochem, Feasibility study
38	Miron, T.	STr, Tr, Geochem
38	Miron, T.	STr, Tr, Geochem
38	Miron, T.	STr, Tr, Geochem
39	Miron, T. and Shank, M.	STr, Tr, Geochem
39	Miron, T. and Shank, M.	STr, Tr, Geochem
40	Naples, K.V.	STr, Tr
41	Noranda Exploration Company, Limited	Geology, Geochem
42	Palkovits, R.J.	Geophys, STr, Tr, Geochem
43	Perri, A.	DD
44	Placer Dome Incorporated	Prospecting
45	Poupore, T.	Dimension stone evaluation
46	Preston Resources Limited	Geology, Geophys, Geochem
47	Rauhala, J.	STr, Tr, Geochem, Geology
48	Rio Algom Exploration Incorporated	Geology
49	Saukko, R.	Geophys
50	Secord Silica Corporation	Geophys, STr, Dimension stone evaluation
51	Sims, W.	STr, Tr, Geology, Geochem
51	Sims, W.	Percussion Drilling, Geology
52	Stewart, R.V.	Geochem
53	Stringer, E.	STr, Tr
54	Taillefer Exploration	STr
55	Tamminen, T.	STr, Tr, Geochem
55	Tamminen, T.	Dimension stone evaluation
56	Tarazi, S.L.	Prospecting
57	Teck Exploration Limited	Airborne Geophys
58	Tremblay, M.	Geophys
59	Van Lith, G.	STr
60	Weiss, W.	STr, Tr, Geophys
61	White, J.W.	STr, Tr, Geochem

contact of Archean mafic metavolcanic and metasedimentary units. Mr. Gervais, with the assistance of M. Shank, Prospector, drilled two conductors detected by the electromagnetic survey. One of the conductors appears to be on strike with mineralized surface outcrop.

M. Gilbert

M. Gilbert conducted a small program of diamond drilling on claims in Salter and May townships. The exploration was conducted to test for copper mineralization hosted in the Pecors Formation. The property is on strike with the former Massey and Hermina copper mines which operated in the early 1900's.

Goldteck Mines Limited

This company completed soil and lithogeochemical surveys over their claim groups in Falconbridge and Street townships. They also completed a self-potential geophysical survey followed by a single, 110 m diamond-drill hole to test a conductor on the Falconbridge Township property. The hole intersected a 6 cm section of massive pyrrhotite and pyrite.

Gordon Salo Contracting Limited

This company's properties are described in the "Property Examinations" section of this report.

G. Hammerlund

G. Hammerlund conducted a geochemical survey of sands and gravels for placer gold potential on a small, unnamed creek draining from Caswell Lake in Aylmer Township.

T. Hanninen and A. Maki

This property is described in the "Property Examinations" section of this report.

Inco Exploration and Technical Services Incorporated

Inco Exploration and Technical Services Incorporated conducted mineral exploration on several townships in the Sudbury Basin, the majority of the work being concentrated on long-held patented ground. In recent years, the focus of their exploration has shifted from gold to base metals. Exploration for the former is now handled by TVX Gold Incorporated, of which Inco Limited owns 62 percent. Exploration in the Sudbury Basin consisted of stripping, trenching, geological mapping, geophysical and geochemical surveys, and diamond drilling.

The best discovery in 1991 was at the former Victor Mine, on the East Range of the Sudbury Basin, in Maclennan Township. This historic property was first patented by J.K. Leslie and G.S. Macdonald as WD 1 in 1890 and subsequently acquired by the British America Nickel Corporation, Limited (Report of the Royal Ontario Nickel Commission, 1917). Through a series of mergers, it was eventually passed to Inco Limited, who mined 134000 tons of nickel-copper ore by 1960. Recent exploration has outlined 4.6 million tons of ore grading 7.30% Cu and 2.25% Ni in a deep, footwall zone, at a depth of over 8000 feet. The company has suggested sinking an exploration shaft 6000 feet deep, at a cost of $40 million, in order to defray the costs of deep-surface drilling. A second, shallower zone, 2600 feet south of the Victor Mine, has been reported to contain reserves of 7 million tons grading 0.50% Cu and 2.17% Ni. The report also states that the footwall zone strikes north and is only 500 feet from the claim boundary with Falconbridge Limited (*The Northern Miner*, November 26, 1991, p.1,2). Earlier reports suggested potential for 20 to 40 million tons of ore in the discovery zone between a depth of 8000 to 8800 feet. The discovery is important in that this part of the Sudbury Igneous Complex (East Range) has in the past been regarded to be relatively barren.

Inco also conducted reconnaissance work for platinum group metals-nickel-copper mineralization on recently acquired lands in the East Bull Lake area.

Jarvis Resources Limited

Jarvis Resources Limited conducted stripping and dimension stone evaluation at their Parkin Township "marble" property. The claims are underlain by contact metamorphosed, lower Espanola Formation limestone which is interbedded with siltstone. The limestone beds may be up to 10 cm thick, with the siltstone beds usually no thicker than 5 cm. There are abundant soft-sediment deformation features such as ball and pillow structures, cross-bedding, and slumping. Post-lithification folding and brecciation is also common. The two rock types differ in response to weathering, with the siltstone forming resistant ridges (Photo 16.1). There are at least five different textures of the "marble" on the property. The company employs a Meyers block cutting system which uses a rotating, diamond-impregnated belt mounted on a swivel arm 6 feet long. The blocks are cut out of the outcrop on as many sides as possible and then removed with as little force as necessary in order to avoid breakage. Approximately 20 to 30 blocks of 10 to 15 tons have been removed. Jarvis Resources is currently attempting to raise funding to purchase cutting and polishing equipment for a tile production facility in Sudbury.

Jarvis Resources also completed a three-hole, 200 m, diamond-drill program on their Street Township mica property. The 11 claim property is underlain by biotitic gneisses hosting bands of micaceous and quartzitic gneisses. The drilling intersected muscovite zones of 20 to 30% over 5 to 15 m intervals in each of the holes, but the majority of core contained subeconomic grades. Feldspar and garnet (± quartz) was the dominant mineral assemblage.

R.G. Komarechka

R.G. Komarechka completed geological mapping and lithogeochemical sampling on a single claim in Hagar Township. The claim is underlain by an ultramafic intrusive, known locally as the "Black Fox Quarry". The fractured peridotitic

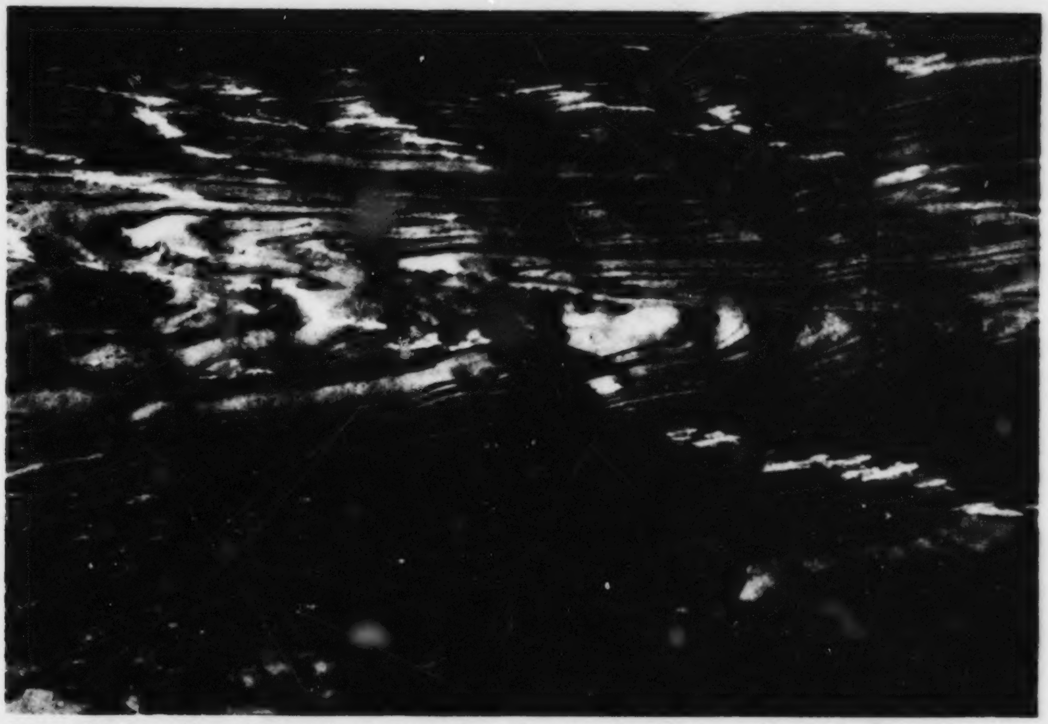

Photo 16.1. Lower Espanola Formation limestone, Parkin Township, Jarvis Resources Limited Property. Tightly folded beds of limestone and siltstone showing differential weathering.

rock has been previously used as aggregate. The current exploration focussed on platinum group metal-nickel-copper potential as well as sand-blast grit potential. Neither commodity nor utility targets proved feasible, although anomalous zinc values were encountered.

R.G. Komarechka also completed stripping on a 7 claim group in Eden Township in order to locate large quartz veins in Huronian Supergroup rocks for use as smelter flux.

A. Leblanc

A. Leblanc completed a single diamond-drill hole on his copper-nickel property in Crerar Township. The core intersected moderately foliated gabbroic anorthosite for most of its length, with minor pyrrhotite and chalcopyrite near the end of the hole at 150 m.

A. Leblanc also completed stripping and percussion drilling on his silica property in Henry Township. At this site, the author observed a coarse-grained quartz vein, 20 by 100 m and trending north-northeast, hosted in biotitic gneisses of Grenville age. Parts of the quartz vein contain minor amounts of pyrite, assaying up to 0.03 ounce Au per ton from grab samples. A local landscape operator has expressed an interested in the stone for decorative aggregate, which may also be suitable for smelter flux.

Stripping and trenching were also completed by Mr. Leblanc on a copper-nickel prospect in Loughrin Township.

O.T. Maki

Soil and till sampling for placer gold were done by O.T. Maki on Vermillion River placer occurrences in Hutton Township.

Manex Granite Incorporated

Manex Granite Incorporated conducted test quarrying at their St. Charles building stone prospect in Casimir Township. The rock is a medium- to coarse-grained, white and black to grey and blue anorthositic gabbro. Dark hornblende and biotite contrast sharply with the light coloured plagioclase. The outcrops contain very little jointing or other fractures and some of the larger blocks required additional cutting to facilitate shipping. Some landscape stone was also quarried and sold to Allstone Quarry Products Incorporated. The blocks are being sent to the company's processing plant in Winnipeg for dressing.

Midas Minerals Incorporated

Midas Minerals Inc. entered into discussions with the Wikwemikong Indian Band to commence a feasibility study to develop a dolomite quarry on Manitoulin Island Indian Reserve No. 26. The band completed a study several years ago which indicated the stone from Silurian Guelph and Amabel formations meets Ministry of Transportation construction aggregate specifications. Both the Band and Midas Minerals have asked for Ministry of Northern Development and Mines funding to assist in the startup phase of the project. Assuming acceptable market conditions, sufficient grade and reserves, and low transport costs by lake freighter, the best case scenario would have the quarry in production in about five years. The Wikwemikong Band has given its approval for the company to begin environmental and market studies. Midas Minerals currently operates three limestone quarries in the Kingston area which produce approximately 750 000 tons of crushed stone annually.

T. Miron

T. Miron conducted exploration on several precious and base metal occurrences during the year. The work includes stripping, trenching, and lithogeochemical sampling on properties in Botha, Rhodes, and Kitchener townships.

T. Miron and M. Shank

T. Miron and M. Shank conducted prospecting on anorthositic gabbros of the East Bull Lake intrusion in Boon and Mandamin townships.

Exploration was also completed at the former "Copenhagen" copper-lead-zinc occurrence in Kitchener Township. This work is described in the "Property Examinations" section in this report.

Noranda Exploration Company, Limited

Noranda Exploration Company, Limited carried out geological mapping and lithogeochemical sampling on claims in Shelly, Marshay, Baynes, Dublin, Onaping, and Scotia townships. The area is underlain predominantly by Archean granites that host block-faulted Archean mafic to intermediate metavolcanic inliers that have been intruded by Nipissing diabase. Several small base-metal occurrences are present in the metavolcanic rocks. The area lacks detailed geological information and thus merits attention.

R.J. Palkovits

R.J. Palkovits completed stripping, trenching, and lithogeochemical sampling on an induced-polarity geophysical anomaly in Davis Township. The area hosts several small copper-nickel occurrences hosted in Gowganda Formation argillite intruded by Nipissing diabase and copper-gold occurrences associated with soda metasomatism.

Placer Dome Incorporated

Placer Dome Incorporated acquired a large claim group near the "Stralak" base metal occurrence in Craig Township. Only minor geological reconnaissance work was completed in 1991. Ground geophysical work is expected to be completed in 1992.

T. Poupore

T. Poupore acquired Espanola Formation limestone ("marble") prospects in Grigg, Parkin and Scadding townships. Samples with various textures from this potential dimension stone are currently being cut and polished for promotional purposes.

Preston Resources Limited

Preston Resources Limited conducted geological mapping, ground electromagnetic, magnetometer, radiometric, and max-min horizontal loop geophysical surveys over their nine-claim group in eastern Roberts Township. The claims are underlain by Huronian metasedimentary rocks, including uranium-bearing Mississagi Formation quartz-pebble conglomerate. A massive chalcopyrite and marcasite vein up to 4 m wide has been reported to outcrop on the property.

J. Rauhala

J. Rauhala completed stripping, trenching, lithogeochemical sampling and geological mapping on part of his claim group in Waters Township. The property is underlain by Mississagi Formation quartzites to the north, and Nipissing diabase intruded by granitic rocks to the south. The diabase hosts several small, nickel-bearing pyrrhotite pods and quartz-vein systems. One of the veins assayed 0.022 ounce Au per ton (Temiskaming Testing Laboratories, Cobalt).

Rio Algom Exploration Limited

Rio Algom Exploration Limited commenced base and precious-metal-potential investigation of Archean greenstone in Gerow Township. The ground is part of the Whiskey Lake greenstone belt that was previously held by Atomic Energy of Canada Limited.

Secord Silica Corporation

The Secord Silica Corporation completed line cutting, ground VLF electromagnetic and magnetometer geophysical surveys, power stripping, and sampling on a 15 claim group in Secord Township. The silica prospect has been the target of various exploration programs over the past several years. Rock varieties being investigated for smelter flux include a micaceous quartzite and a feldspar-quartz-biotite amphibolite gneiss.

W. Sims

Exploration and geology of properties held by W. Sims are described in the "Property Examinations" section of this report.

R.V. Stewart

R.V. Stewart completed lithogeochemical sampling on four claims in Loughrin Township. Know as the "Page" garnet property, the recent exploration identified zones of significant garnet mineralization (greater than 10%) hosted in hornblende gneiss. However, beneficiation samples yielded 10 to 15% biotite which detracts from the economic viability of the garnet. Diamond drilling has been recommended to outline the extent of this potential deposit.

Taillefer Exploration

Taillefer Exploration conducted minor stripping and trenching on a historic copper showing and decorative stone property in north-central Aylmer Township. The rock is an albitized, brecciated, buff Gowganda Formation siltstone and greywacke with a matrix of hydrothermal quartz and carbonate. Bornite and chalcopyrite mineralization occasionally occur in the breccia. The rock is used locally in landscape applications.

Teck Exploration Limited

Teck Exploration Limited completed airborne magnetometer and electromagnetic geophysical surveys over claims in McCarthy and Sheppard townships. The property lies over the west-central portion of the Wanapitei (Temagami) Magnetic Anomaly and adjacent to the Falconbridge Limited "Mirage" project.

J.W. White

J.W. White completed stripping, trenching, and lithogeochemical sampling on the Hanwood Lake gold prospect in Roosevelt Township. The property hosts four small gold occurrences within folded and east-trending Huronian metasedimentary rocks. Pyritiferous blue and white quartz veins, up to 1 m wide and 100 m long, have been exposed by previous work. In the mid-1930's, a 3400 pound bulk sample was taken for analysis, but no results were reported.

PROPERTY EXAMINATIONS

T. Holmstrom (Richardson Lake) Precious Metals Occurrence

This small, sulphide precious-metals occurrence is located near the west shore of Richardson Lake in Rhodes Township at UTM co-ordinates 470800E 5196900N, approximately 55 km from Sudbury. Access is by bush road from Cartier or float plane to Richardson Lake.

No previous information has been published, and only some handwritten correspondence from the 1930's makes note of this locality. The occurrence was initially staked in the 1930's, by T. Holsmstrom, who is known for the discovery of several precious- and base-metal occurrences in the area, particularly in Botha Township to the east. Mr. Holmstrom conducted trenching on at least two different sulphide zones which were observed by the author. Other workings are covered by vegetation. Bharti Laamanen Mining Incorporated recently re-discovered the old workings and staked four claims. The sulphide occurrence is found on claim S.1095077. Outcrops on the claims are relatively sparse. In 1991, the company completed trenching on the old workings, ground magnetometer and VLF electromagnetic geophysical surveys, and limited geological mapping over the entire property (Sudbury Resident Geologist's assessment files). The regional geology has been described by Dressler (1980).

The area in the vicinity of the claims is underlain by east-trending Archean mafic metavolcanic rocks termed by Dressler (1980) as amphibolite, as well as intermediate to felsic metavolcanic rocks. Some iron formation is present within the amphibolite and at the amphibolite-intermediate to felsic metavolcanic contact. All rock units have been intruded by granitic rocks, particularly to the north. Paleoproterozoic Huronian Supergroup sedimentary rocks unconformably overlie, or are in fault-contact with, the Archean units.

The amphibolite in the area of the precious metals showing is fine- to medium-grained and well foliated with bands of feldspar, quartz, and hornblende. The rock is dark green to black, and locally weathers to dark brown. Foliation appears to strike 280° and dip 40°N. The bands are up to 10 cm wide and exhibit tight, small-scale folding in hand specimen. Thin-section analysis shows hornblende altering to epidote and chlorite. The amphibolite-intermediate to felsic metavolcanic contact is sharp and strikes 290° and dips 85°S. The intermediate to felsic unit is fine-grained to aphanitic, light grey to light green, and weathers grey to buff. Fine laminations are present and may be representative of a primary sedimentary structure, however, most features have been obliterated by alteration. The rock appears highly epidotized in hand specimen and the thin-section reveals plagioclase crystals are highly saussuritized.

Zones of sulphide mineralization and gossan are present at the contacts of the amphibolite-intermediate to felsic metavolcanic rock in the trench (Figure 16.3). The only sulphide observed was fine- to medium-grained pyrite, occuring as either massive mineralization or abundantly disseminated within the intermediate to felsic metavolcanic unit and associated with pervasive silicification. Quartz veins, from 1 to 10 cm wide, parallel the strike of the units (ie. 290°). The massive pyrite from the trench assayed 1.7 ounces Ag per ton and 0.003 ounces Au per ton (Temiskaming Testing Laboratories, Cobalt). Samples of the disseminated pyrite were consistently low in their precious metals content. A possible fault, trending 300°, cuts the amphibolite in the north end of the trench, but does not appear to have any control on mineralization or alteration. Approximately 30 m east-southeast of the trench, on the shore of Richardson Lake, occurs a small outcrop of weak, finely banded iron formation composed primarily of magnetite and chert with compositional banding in the magnetite beds up to 10 mm thick. Minor pyrite is also present within the magnetite beds. Lorrain Formation quartzite unconformably overlies the Archean units in the northeast part of the claim group.

The recent geophysical surveys by Bharti Laamanen Mining Incorporated suggest some magnetic anomalies may represent mafic dikes. However, none have been mapped in the immediate area. The VLF electromagnetic survey has identified a northwest-trending conductor approximately 100 m east of the trench (Lambert and Turcotte 1991). This conductor may be an extension of the exposed sulphide zone. The company plans to conduct trenching over this conductor and detailed geological mapping over the claims in 1992.

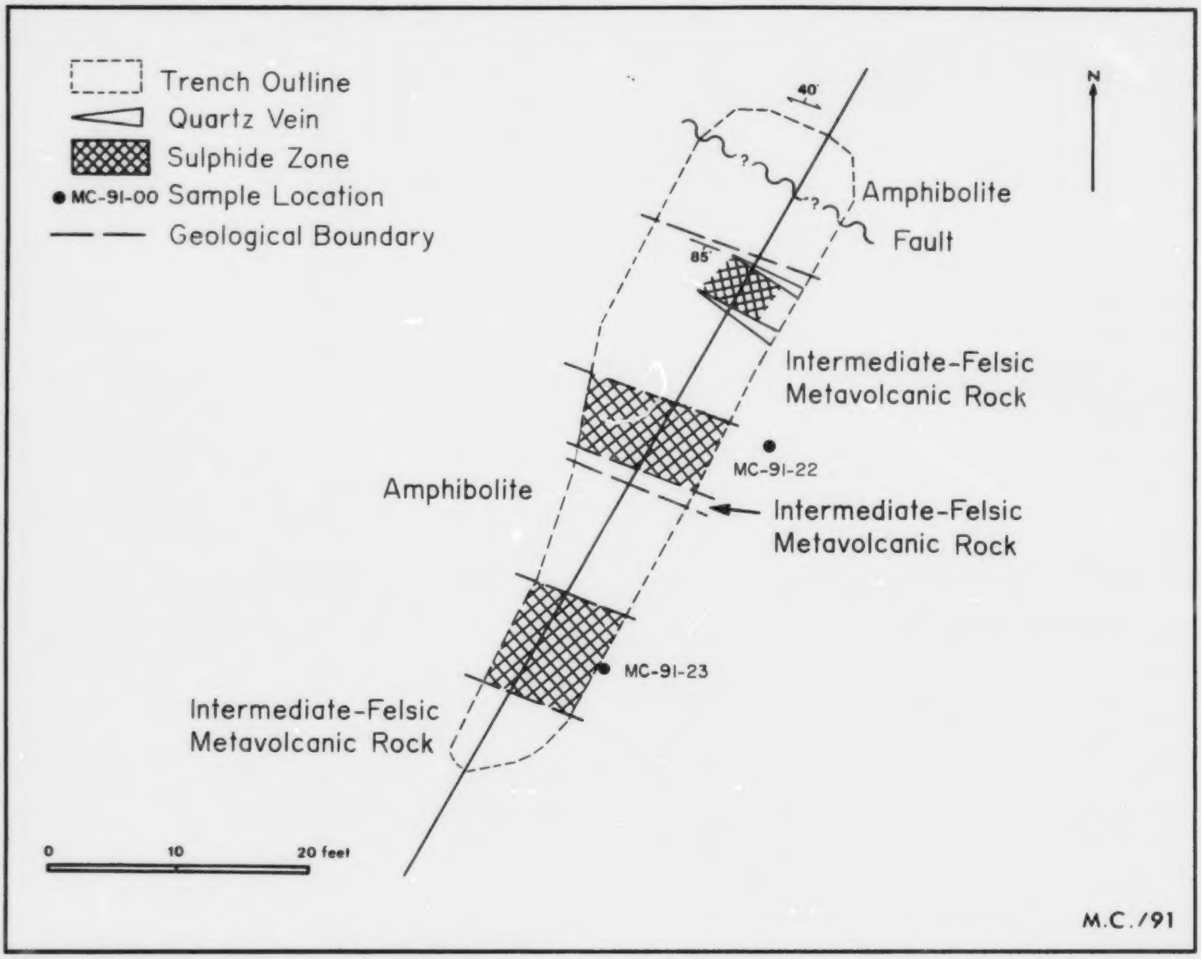
Trench Outline
Quartz Vein
Sulphide Zone
MC-91-00 Sample Location
Geological Boundary
N
40°
?
?
Amphibolite
Fault
85°
Intermediate-Felsic Metavolcanic Rock
MC-91-22
Amphibolite
Intermediate-Felsic Metavolcanic Rock
MC-91-23
Intermediate-Felsic Metavolcanic Rock
0
10
20 feet
M.C./91

Figure 16.3. T. Holstrom (Richardson Lake) precious metals occurrence, Rhodes Township, Bharti Lammanen Mining Incorporated. Geology of the main trench.

Chief Lake Gold Occurrences

The Chief Lake gold occurrences are located southeast of Chief Lake, in northern Tilton Township at UTM co-ordinates 5133500E 500005N. The property is located approximately 14 km south of Sudbury. Access is by bush road and a 2 km trail, or by float plane to Chief Lake.

No detailed geological maps or reports exist for Tilton Township, and there is little information in the Sudbury Resident Geologist's assessment files. Prospecting in the 1930's located a small zone of gold mineralization on eight patented claims currently held by N. Mammina (Figure 16.4). Noranda Exploration Company, Limited conducted trenching and mapping on this zone in 1938 with limited results. Exploration on the property appears to have been dormant from 1939 until 1983. From 1983 to 1987, Noranda, Falconbridge Limited, Cominco Limited, and the Canadian Nickel Company Limited all conducted minor lithogeochemical sampling on the property, again with poor results (Sudbury Resident Geologist's files). In late 1990, T. Hanninen and A. Maki discovered a zone of anomalous gold mineralization approximately 1.5 km southeast of the original showing. Hanninen and Maki subsequently staked 16 claims in the area. The terrain is somewhat rugged and outcrop exposure in the area is good, usually above 35 percent.

Most of this area is underlain by felsic intrusive rocks of the Chief Lake Batholith. The Chief Lake Batholith is part of a series of felsic plutonic rocks that occur along the Grenville Front and represents the northeast extension of the Killarney Batholith (Card et al. 1975). The intrusive is medium-grained and porphyritic and appears to be fairly uniform throughout in this area. The phenocrysts are perthitic plagioclase of variable size and rarely exceed 2 cm in length.

Several remnants of Huronian Supergroup metasedimentary rocks lie in contact with the Chief Lake Batholith. Most remnants are unmapped and rarely exceed 10 000 m². They appear to be coarsely recrystallized rocks of Lorrain

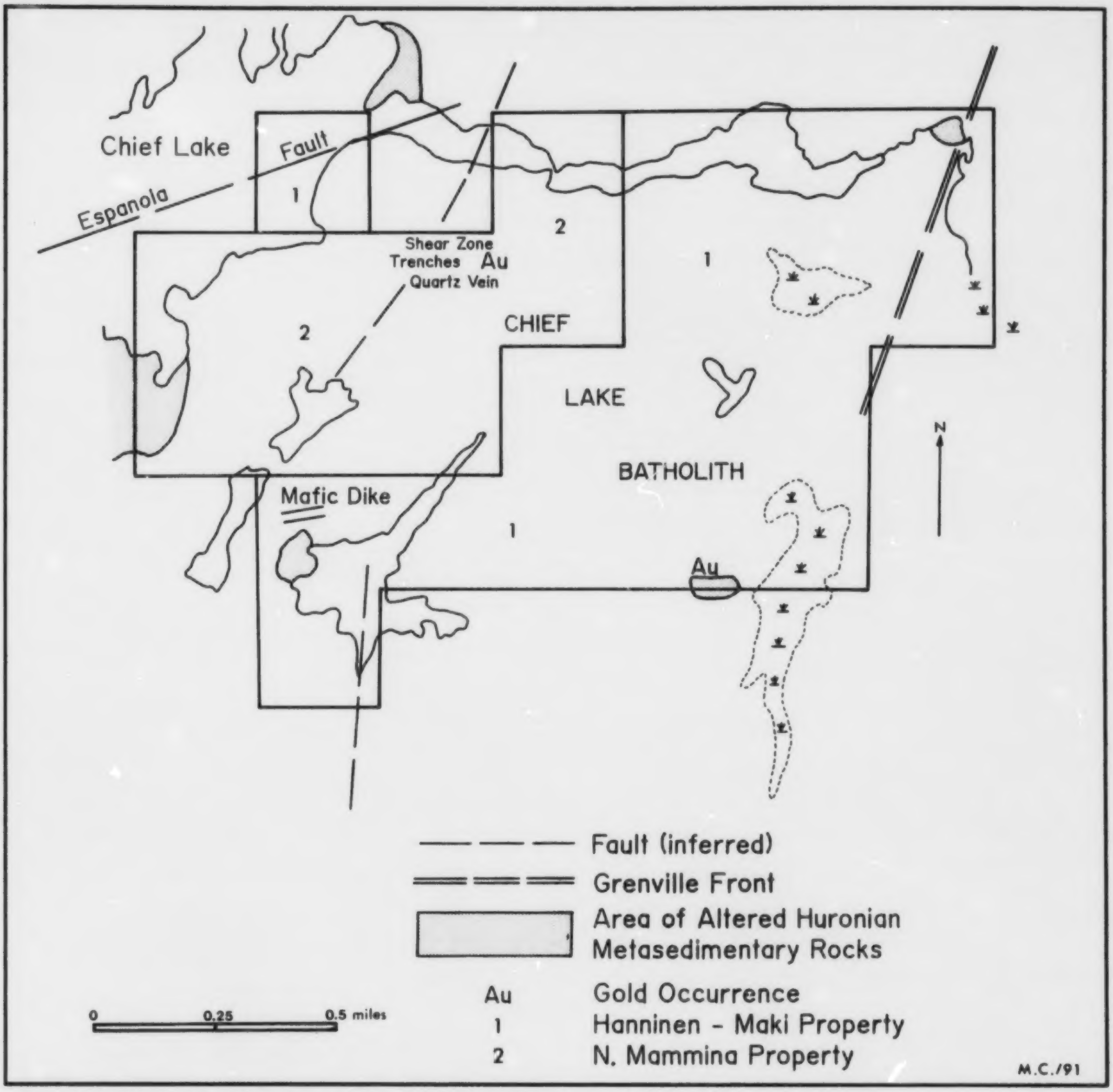
Chief Lake
Espanola Fault
1
2
Shear Zone
Trenches Au
Quartz Vein
CHIEF
LAKE
BATHOLITH
Mafic Dike
Au
N
Fault (inferred)
Grenville Front
Area of Altered Huronian Metasedimentary Rocks
Au Gold Occurrence
1 Hanninen - Maki Property
2 N. Mammina Property
0
0.25
0.5 miles
M.C./91

Figure 16.4. Chief Lake gold occurrence, Tilton Township, T. Hanninen, A. Maki. Geology of the claim group.

Formation or Gowganda Formation and contain minor pyrite, arsenopyrite, and pyrrhotite. Two hand specimens of this material collected near the southern claim boundary assayed 0.129 and 0.124 ounces Au per ton (Temiskaming Testing Laboratories, Cobalt). The original showing from the area of the trenches has been described as a quartzite inclusion, approximately 100 by 15 m, striking 030°. A shear zone 10 cm wide cuts the inclusion at 195° and dips steeply to the south. The shear zone hosts considerable pyrite, biotite, and native gold. The best assay from this zone was reported to be 0.26 ounces Au per ton over 30 inches (Sudbury Resident Geologist's files). Relatively unaltered Mississagi Formation argillite lies in fault-contact with the Chief Lake Batholith on the north shore of Chief Lake. This unit contains approximately 3% medium-grained, euhedral pyrite, but lacks gold mineralization. It is interesting to note that the Long Lake gold mine, located 11 km to the southwest, produced approximately 57000 ounces Au from auriferous, pyrite-bearing Mississagi Formation sandstone (Gordon et al. 1979). A fine-grained, olivine-bearing, late mafic dike, 5 m wide, outcrops in the southeast corner of the property.

The south branch of the Espanola Fault trends east-northeast through the northern part of these properties and is largely covered by Chief Lake. Several smaller north-northeast-trending faults were observed, but do not appear to have any associated gold mineralization. The Grenville Front has been suggested to occur just east of the property, but its exact location is hidden by water and swamp.

Future exploration will focus on locating other auriferous quartzite-rich zones from which the gold may be extracted as well as using the silica as smelter flux.

Copenhagen Copper-Lead-Zinc Occurrence, Kitchener Township

The Copenhagen sulphide occurrence is located east of Copenhagen Lake in the southeast corner of Kitchener Township, 34 km north of Sudbury at UTM co-ordinates 492900E 5184650N.

Access is by Regional Road 84, north of Capreol, and then via a bush road west to Ironside Lake. A good trail heads southwest to the showing. A group of 20 claims in Hutton and Kitchener townships, including this showing, was staked in 1990 by W. Thibault.

The area is predominantly underlain by a large quartz monzonite batholith which contains inclusions of Archean metavolcanics and Nipissing-type gabbroic rocks. Northwest-trending diabase dikes occur to the north.

The original showing was discovered and explored prior to the 1930's. The first description is by Kindle (1932):

> Most of the development work has been done in the vicinity of a contact between granite and greenstone. Some diamond-drilling has been done along the contact and to the east of a test pit sunk on a graphitic shear zone that strikes N65°E and intersects the greenstone. This shear zone is mineralized with quartz and sulphides over a width of 8 feet.

The geology of the area is described by Card and Meyn (1969). They concluded:

> ...the sulphide mineralization in Kitchener township is closely associated with lean, banded iron formation in a metavolcanic remnant enclosed by granitic rocks. The mineralization has been tested by pits and a shallow shaft (27 feet). In 1957 three drill holes, totalling some 735 feet, were put down. A selected sample...was assayed...with the following results: copper, trace; nickel, trace; lead, 2.01%; zinc, 1.25%. A fine-grained mixture of galena and spalerite is visible in the specimen.

The three holes drilled in 1957 were collared just north of the shaft and intersected gabbro with occasional disseminated blebs of pyrrhotite.

In 1967, Scotia Mines Limited completed geological mapping and ground magnetometer and electromagnetometer geophysical surveys over the area using 300 foot line-spacing. Three conductors coincident with higher magnetics were recommended for drilling.

The ground has been held by various individuals since 1967 and only minor power stripping and manual work have been completed. Preliminary exploration, including prospecting and sampling, was conducted by T. Miron and M. Shanks during 1991.

The Copenhagen occurrence consists of a low, flat outcrop containing a water-filled pit, about 3 by 3 m, in a stripped area of approximately 8 by 10 m. The remainder of the area is covered by shallow, boulder-strewn drift. Highly siliceous, weak iron formation, approximately 4 m wide trending 100°, is in contact with a gabbro (probably Nipissing-type), to the north. A discontinuous lense of quartz-carbonate approximately 0.5 m wide occurs along this contact on the west wall of the pit. Minor quartz-carbonate also occurs perpendicular to the contact. Minor pyrite, pyrrhotite, and occasional chalcopyrite, galena, and sphalerite occur with the siliceous iron formation near the contact. On the east side of the pit the contact is marked by a 0.4 m wide shear zone which contains some massive pyrrhotite.

Approximately 400 m southwest of the shaft, an old pit is located just north of Kumska Creek within greenstones and weak iron formation. The iron formation strikes at 070° and dips 70°NW. The pit is located about 10 m north of the metavolcanic-quartz monzonite contact. A large hill of quartz monzonite rises about 120 m south of Kumska Creek.

Quartz veins cutting greenstone and iron formation in the pit contain massive to semi-massive pyrrhotite with recrystallized magnetite and minor chalcopyrite and pyrite. Pyrite is also present in the weak iron formation. Sample 91-BIG-0080 from a smaller pit on the north flank of the main pit contained up to 5% sulphides, mostly pyrite with minor chalcopyrite and sphalerite, within white to clear quartz. Sample 91-BIG-0081 contained massive pyrrhotite, recrystallized magnetite, and minor chalcopyrite and pyrite.

Approximately 50 m to the east, some recent pits have been blasted on weak, siliceous iron formation just north of the quartz monzonite contact. The iron formation strikes 040° and dips 70°NW. Narrow quartz-feldspar veins cut the metavolcanic rocks near the quartz monzonite and occasionally contain fine fractures filled with pyrite, chalcopyrite, magnetite, pyrrhotite, and molybdenite (refer to sample 91-BIG-0082 below). The siliceous iron formation is cut by quartz veins 2 to 7 mm wide which contain blebs of chalcopyrite. Pyrite, chalcopyrite, and occasional galena and sphalerite occur as disseminations parallel to the primary banding within the siliceous iron formation. Refer to samples 91-BIG-0083 and 91-BIG-0084 below (Temiskaming Testing Laboratories, Cobalt).

South of Kumska Creek a small pit has been dug into a possible fault breccia containing angular diabase or gabbro clasts in a cherty to quartz-carbonate matrix, which is occasionally vuggy and contains minor chalcopyrite in the vugs. An outcrop of olivine diabase is located south of this breccia. The northwest trend of Kumska Creek may follow a late diabase dike and/or fault zone. A northwest-trending magnetic

Sample No.	Au opt	Ag opt	Cu ppm	Zn ppm	Mo ppm	Ni ppm	Pb ppm	Pd ppm
91-BIG-0080	Nil	Tr	275	1000	-10	80	213	-10
91-BIG-0081	Nil	Nil	687	224	-10	81	142	-10
91-BIG-0082	Nil	Tr	2210	110	56	19	17	-10
91-BIG-0083	Nil	Nil	300	1260	-10	91	1035	-10
91-BIG-0084	Tr	Tr	1700	130	9	20	31	-10

anomaly may be a reflection of the diabase but may also indicate weak iron formation or massive pyrrhotite mineralization.

Sims Garnet Occurrence, Davis Township

W. Sims holds 11 claims which straddle the southern boundary between Davis and Janes townships, about 35 km northeast of Sudbury. Garnet occurs within Mesoproterozoic rocks immediately south of the Grenville Front Boundary Fault.

The property can be reached by travelling north from Hagar (on Highway 17), for 22 km along Highway 535 which cuts through the centre of the claim group. The main showing is located on the east side of the road about 0.5 km south of the Canadian National Railways line at UTM co-ordinates 544200E 5164950N.

The property has been staked in the past but there is no recorded assessment work. Some stripping over a 50 by 10 m area runs perpendicular to the trend of the gneissosity. Narrow trenches have been blasted across the garnet-bearing units. In 1988, airborne magnetic and VLF electromagnetic surveys were flown over the property for W. Sims. A total of 14 percussion-drill holes, totalling approximately 280 m, were drilled in 1991 and garnets were encountered in the drill chips.

Davis Township was mapped by Thomson and Card (1963) and Janes Township more recently by Dressler (1979). The area is underlain by metasedimentary rocks, amphibolites, and an anorthositic suite of rocks. Biotite and biotite-hornblende-plagioclase gneisses are believed to represent a metagreywacke with garnet occurring as a common mineral. Feldspathic gneiss probably represents a meta-arkose. The gneisses are occasionally migmatitic.

The rocks are intruded by amphibolites which are possibly equivalent to the Nipissing gabbros and the anorthosite suite intrusive rocks that are common to this part of the Grenville Province. They have a higher magnetic susceptibility than the metasediments and can be located and defined by magnetic surveys.

W. Sims expressed interest in the potential use of the garnet as an abrasive, so a visit to the property and a map of the main showing, at 1:2000 scale, was completed in August. An area about 50 by 20 m has been stripped over a low hill and across the trend of the gneissosity, which strikes approximately 285° and dips 70°S. Narrow trenches have been blasted previously to obtain fresh samples. A 50 by 10 m area of outcrop extends to the east, from the north end of the stripped area.

Hornblende-biotite-quartz-feldspar gneiss predominates. It is up to 15% migmatitic and contains up to 15% garnet, ranging in size from 1 mm to 2 cm. The garnets are usually slightly rounded and occur with the hornblende-biotite-rich layers. Thin-section analysis revealed the garnets to be strongly poikiloblastic and are actually garnet-quartz balls containing approximately 30% quartz and 5% opaque minerals, possibly magnetite.

At the north end of the stripped area a 2 m wide quartz-feldspar unit appears to extend at least 55 m west to the road. It contains approximately 20% better-formed garnets from 2 mm to 1 cm in size. The rock weathers rapidly and becomes quite friable. In thin section the garnets again tend to be rounded, commonly poikiloblastic and contain approximately 10% quartz and minor magnetite. Dark brown biotite occasionally is curved around the garnet. Immediately south of the quartz-feldspar unit is a discontinuous biotite-actinolite-hornblende-quartz schist which contains up to 15% well-rounded garnet-quartz balls up to 7 cm in size. Macroscopically, the garnets are poikiloblastic with approximately 30% quartz inclusions.

Garnets are located 40 m east along the entire length of the outcrop. A quartz-feldspar-muscovite schist and gneissic unit contains minor amounts of kyanite and well-rounded, impure garnets, up to 15 cm in diameter, the largest located within the schist. Generally, most garnets are round, small, and erratically distributed.

Higher quality garnet is used as loose, angular grains, and powders for grinding and lapping glass, ceramics and other materials; for coated and bonded abrasive products such as sandpaper; and for abrasive wheels for grinding and finishing.

Low quality grades are used for cleaning and conditioning aluminum, other metals, and in mixed media filters.

The world's most important producer of high quality garnet is the Barton Mine in New York State, which has been in continuous production since 1878, while low quality garnet resources are described as unlimited.

Small, specialized markets and the relatively large capital investment required for development discourages the opening of new garnet deposits. Several deposits examined in the

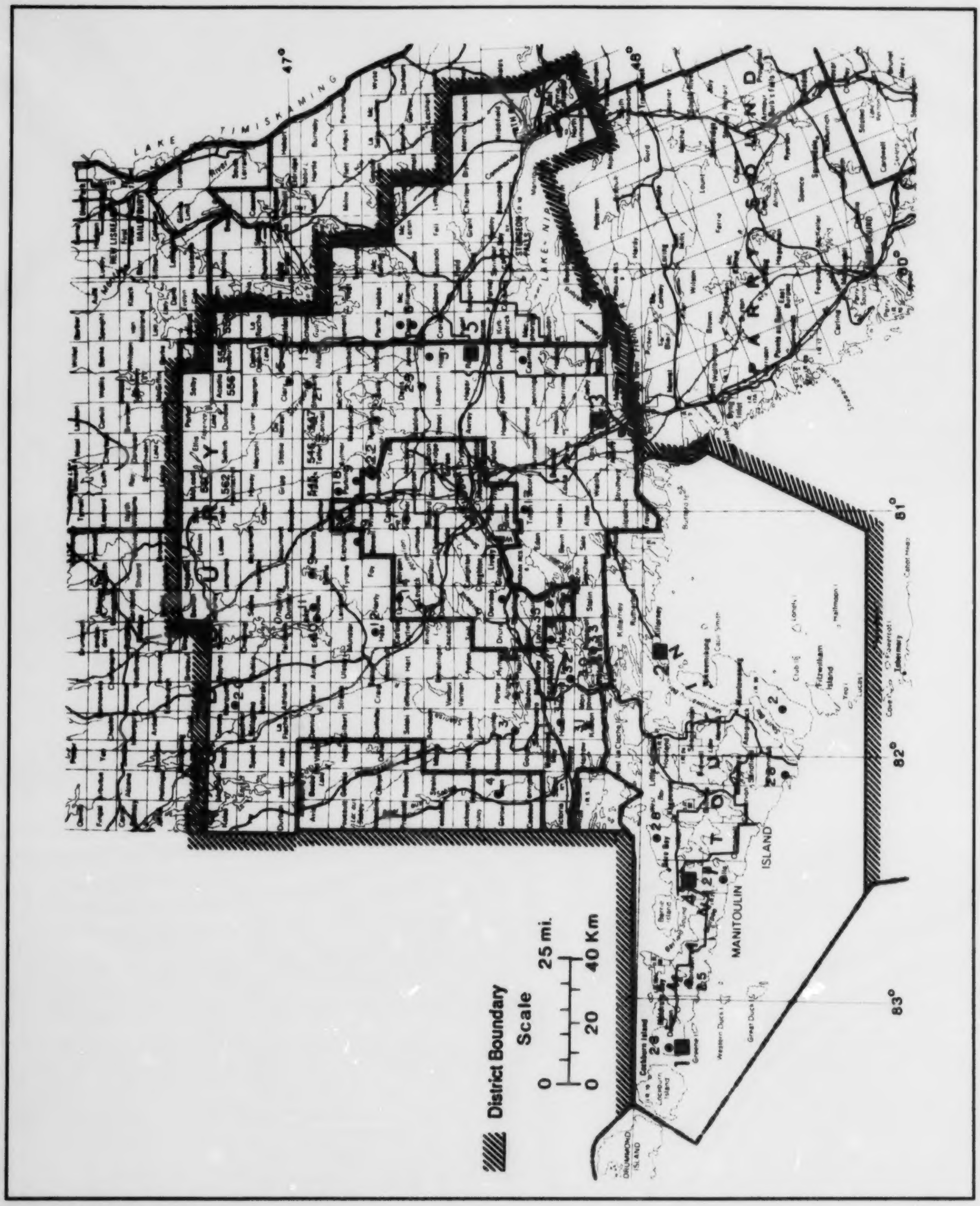
LAKE TIMISKAMING
LAKE NIPISSING
MANITOULIN ISLAND
DRUMMOND ISLAND
District Boundary
Scale
0 20 25 mi.
0 40 Km
47°
48°
80°
81°
82°
83°

Figure 16.5. Sudbury Resident Geologist's Area.

EXPLANATION

Sudbury Resident Geologist's District

● **Property Visits, 1991 (keyed to Table 16.3), 1991**

■ **Producing Quarries, 1991**

1. Standard Aggregates Incorporated	Dolomite
2. Unimin Canada Limited	Silica
3. Carman Construction Incorporated	Silica
4. Hercules Stone Limited	Limestone
5. Crea-Mac Contracing Company Limited	Feldspar

☐ **GDIF (Geological Data Inventory Folio)**

District Boundary

Sudbury area have been uneconomic in the past for a variety of reasons: 1) insufficient tonnage, 2) garnets are inclusion filled or pitted, 3) quartz with garnet makes beneficiation difficult, and 4) garnets break down under heat treatment.

If costs can be kept competitive, and because of the current danger of respiratory disease from the use of silica, the potential exists for the use of garnet in the sandblasting market.

G. Salo Properties, Lake Panache Area

Three occurrences are currently held by G. Salo in the Lake Panache area, located about 35 km southwest of Sudbury. Access to Lake Panache is via Regional Road 10 which leads south from the Town of Whitefish, located about 25 km west of Sudbury along Regional Road 55.

The area is underlain by Proterozoic rocks of the Huronian Supergroup and Nipissing-type mafic intrusions. The Grenville Front Tectonic Zone with its associated felsic intrusions is located about 10 km to the southeast. The area is characterized by a series of tight, parallel folds with east- to northeast-trending fold axis. Several major faults, part of the Murray Fault system, trend east and east-northeast, while north- to northwest-trending faults tend to give an erratic appearance to the stratigraphy in the area. There are also two soda-rich fenite bodies located to the northeast, as well as late northwest-trending diabase dikes. The area geology is described by Card (1978) and Card et al. (1975).

CHELLEW COPPER OCCURRENCE

This copper occurrence is located southwest of Little Panache Lake at UTM co-ordinates 470225E 5124400N. It can be reached by taking the road along the north shore of Lake Panache for 2 km, west from the end of Regional Road 10, and then by trail northwest to the showing.

The property was first described by Card et al. (1975):

> Sulphide mineralization, mainly pyrite and chalcopyrite, is in a silicified shear zone in rocks of the Espanola Formation. Disseminated sulphide minerals, generally present in amounts of about 10 percent, are exposed in an east-west-trending zone up to 10 feet (3m) wide over a length of about 100 feet (30m).

In 1957, Chellew Mines Limited completed minor trenching on the occurrence. They also diamond drilled a 45° hole to test the mineralization below the pit. Chalcopyrite and pyrite occurred disseminated in the core, associated with blue-grey quartz veins, within an altered quartzite. It averaged 0.48% Cu and trace Au over the total length of 40.3 feet (Sudbury Resident Geologist's assessment files).

Mattagami Lake Mines Limited acquired eight claims containing the showing in 1975 and conducted an induced polarization and magnetometer geophysical surveys using a 400 foot grid spacing. They completed six diamond-drill holes totalling 2564 feet. Two holes were drilled beneath the trenches. Hole D-B-76/5 returned 1.62% Cu over a length of 33.4 feet at a 120 foot vertical depth. Hole D-B-76/5 returned 0.50% Cu over a length of 20.0 feet at a vertical depth of 330 feet, and 0.42% Cu over a length of 31.0 feet from the 16.0 to 47.0 foot interval. The holes encountered quartzite in the south and a conglomerate, with a greywacke matrix, to the north. Copper was associated with a fractured grey quartz. Gold values were generally low (Sudbury Resident Geologist's assessment files).

Another four holes were drilled on induced polarization ground geophysical anomalies and intersected mostly conglomerate with minor sulphides.

In 1986 Uranex Resources Limited acquired six claims over the showing and conducted ground electromagnetic, magnetic, and radiometric geophysical surveys. The electromagnetic survey located only weak conductors, the best responses from the magnetometer survey coincided with the trenching, and the radiometric survey recorded only low values. A geological mapping survey failed to locate the showing. The company geology report stated that:

> It appears from the geology that a series of north to northwesterly trending block faults occurs on the property. This faulting has been interpreted to explain the difficulty in stratigraphic correlation. No evidence was found in the field for the presence of these faults.

The Louise-Eden geology map (Hum 1986, ODM Map 2229) shows this occurrence located immmediately north of the axis of the Brady Syncline, which contains a core of Serpent Formation. Espanola Formation is located south to Lake Panache with Espanola Formation and then Bruce Formation to the north. The showing is located on a small outcrop of sandstone interpreted as part of the Espanola Formation.

The trail to the Chellew occurrence follows a well forested (cedar, spruce, balsam) valley with a ridge of Espanola Formation limestone and calcerous siltstone to the south. The showing is located on a low outcrop vegetated by sparce occurrences of maple, oak, and white pine.

A white arkosic-quartzite (possibly Serpent Formation), is in contact with a pebbly wacke (possibly Bruce Formation), at the north end of the outcrop. Two shallow trenches within a 16 by 16 m area on the north side of the outcrop crosscut the best sulphide mineralization hosted in what appears to be the pebbly wacke. Two small pits located to the southeast appear to be in the quartzite.

Chalcopyrite and pyrite mineralization occur with pervasive, pink-white albitization and associated narrow quartz veins that have a maximum width of 10 cm. The quartz veins become narrower and fewer away from the main showing. The following assay results were obtained from grab samples taken this year. Sample 91-BIG-0030 is from the pervasive alteration and includes some vein quartz and a few specks of pyrite. Sample 91-BIG-0031 is from quartz veins containing chalcopyrite (Geoscience Laboratories, Ontario Geological Survey, Toronto).

About 300 m southeast of the above showing, an area about 30 by 30 m was stripped in 1989 and a small pit excavated into a rusty gossan zone. The gossan zone was discovered while prospecting with a magnetometer. The showing is located at the base of the north side of a hill adjacent to a cedar swamp.

At this locality, Espanola Formation limestone and calcareous siltstone is in contact with the underlying Bruce Formation pebbly wacke. Albitization occurs along the contact and affects both units. The pit was excavated in what appears to be the most abundant mineralization within albitized Espanola Formation. Pyrite, chalcopyrite, and magnetite occurs along small fractures within an area of strong jointing. Minor disseminated pyrite and chalcopyrite occur with the less altered limestone to the east. Chalcopyrite occurs in narrow albitized beds within visually unaltered limestone and as small stringers, 0.5 cm wide, up to 10 m from the albitized contact.

Sample 91-BIG-0035 is from the altered Espanola Formation and sample 91-BIG-0036 contains pyrite and chalcopyrite from the unaltered limestone described above (Geoscience Laboratories, Ontario Geological Survey, Toronto).

Albitization and associated mineralization appears to follow the lithological contacts but it is also known to be spatially related to the regional faults in the area. The stratigraphy is more complex than previously indicated and the lack of exposure makes interpretation and prospecting difficult.

A small zone of albitization with associated pyrite and pyrrhotite mineralization occurs in the roadcut immediately north of Little Panache Lake. It is associated with the Little Panache Lake Fault zone and has been previously mapped as a felsic intrusion.

TRUMAN TOWNSHIP, COPPER-NICKEL SHOWING

This copper-nickel occurrence in Truman Township is located on the south shore of Lake Panache, approximately 10 km west of the public landing, at UTM co-ordinates 464000E 5119700N. Access is by boat and a 0.8 km trail to the main showing. The claims are located immediately west of a silica quarry operated by Carman Construction Incorporated.

The geology was most recently mapped by Debicki (1977). The property is underlain by calcareous rocks of the Espanola Formation cut by a series of northeast-trending faults which form part of the Lake Penage Fault, and a later series of northwest-trending faults.

Several claims were staked in the area in 1952 and numerous pits found on the property probably date to this time period. Lac Minerals Limited conducted regional airborne magnetometer and electromagnetometer geophysical surveys

Sample No.	Cu ppm	Ni ppm	Pb ppm	Zn ppm	Au ppb	Pt ppb	Pd ppb
91-BIG-0030	160	26	-10	-10	22	-1	-1
91-BIG-0031	24000	230	-10	21	177	-1	-1
91-BIG-0035	330	101	-10	-10	22	-1	2
91-BIG-0036	31000	620	-10	66	21	-1	1

in 1983 which covered a portion of the current Salo claim. A weak electromagnetic conductor apparently coincides with the mineralization found in the main pit. G. Salo staked six claims in the area of the old staking in 1986. In 1987-88 he conducted geophysical ground magnetometer and VLF electromagnetic surveys using a 60 m grid spacing. While conducting the surveys, he located an old pit (known as Pit No.1) which had been backfilled with the broken muck. This pit contains massive pyrrhotite, pyrite, and chalcopyrite within a 10 m wide quartz vein. Three VLF electromagnetic anomalies attributed to structure were located in the vicinity of Pit No.1 and a strong, single station magnetic anomaly was located about 30 m southeast of Pit No.1. In 1988 a magnetometer geophysical survey using a 30.5 m grid spacing was conducted in the area of the main showing. The main pit was stripped and washed, and a 5.5 m deep pit (Pit No.10) sunk on the magnetic anomaly to the southeast revealed massive sulphide mineralized. Further stripping of overburden, sampling, and geophysical surveys took place in 1989. The magnetic surveys indicated a limited extention for the main mineralized zone.

The area is characterized by low hills with sporadic outcrops and drift-filled valleys. An area approximately 35 m^2 has been cleared around Pit No.1, which is located on the southwest side of a low hill. A northeast-trending lineament 20 m west of the pit possibly represents the Lake Penage Fault. Extensive drift is encountered to the south. White vein quartz is located near the contact between a narrow, amphibolitic gabbro dike to the north and contact metamorphosed limestones and calcareous siltstones to the south. Both carbonatized amphibolite and altered Espanola Formation clasts are contained in the vein quartz. The quartz is milky white and contains up to 75% pyrrhotite, 20% pyrite, and 5% chalcopyrite. The quartz may have formed as large crystals with the sulphides later filling in the voids, as evidenced by compositional layering in vugs. The average of six chip samples taken across 5.4 m returned values of 0.48% Ni, 0.31% Cu, 0.12% Co, 71 ppb Au, less than 10 ppb Pt, and 52 ppb Pd (Sudbury Resident Geologist's assessment files). Pyrite-marcasite occurs as masses, spheroidal segregations and composite cubes, up to 5 cm along the sides, within the pyrrhotite. Albitization occurs adjacent to the massive sulphides within the Espanola Formation near the quartz vein and as narrow alteration halos along fractures.

Three samples from the Pit No.1 area were collected for analyses. Sample 91-BIG-0040 contained pyrite and minor chalcopyrite within quartz. Sample 91-BIG-0041 contained massive pyrrhotite with minor chalcopyrite. Sample 91-BIG-0042 is from an altered gabbro clast within the quartz vein (Temiskaming Testing Laboratories, Cobalt).

Sample No.	Cu ppm	Ni ppm	Au opt	Pd ppm
91-BIG-0040	6280	40	.002	24
91-BIG-0041	948	4408	.012	53
91-BIG-0042	84	32	Nil	-10

Trenching at Pit No.10 encountered bedrock at 0.5 m, comprised of albitized Espanola Formation, chlorite breccia, a strongly oxidized zone, and 75% sulphides within a quartz-carbonate vein. The pit bottoms in the sulphide-bearing quartz-carbonate vein which appears to strike northeast and dip 40°SE. The average assay values of the sulphides over a 3 m chip sample are is 0.73% Ni, 0.20% Cu, 0.05% Co, 10 ppb Au, 72 ppb Pd, less than 1 ppb Pt (Sudbury Resident Geologist's assessment files).

A stripped area, approximately 40 m west of Pit No.1, exposes slightly albitized Espanola Formation which has been fractured and flooded by milky white to steel-blue, grey quartz-carbonate containing occasional massive sulphide blebs. The general trend of the quartz is 080°.

Falconbridge Limited examined several samples of the massive sulphide material using electron probe and X-ray diffraction. Massive pyrite and marcasite contain rare inclusions of violarite. The pyrite and marcasite are intergrown and occur in about equal proportions. The massive pyrrhotite contains rare inclusions of violarite, less than 20 microns in size and less than 0.1% by volume.

Actively hydrothermal solutions appear to have followed lithological contacts and the many faults in the area. The silica may have originated from the Eden Lake or Grenville Front plutons (1750 Ma) about 20 km to the east. The albitization of siliceous sediments may also have released a large amount of the silica. The origin of the massive sulphides remains unanswered.

Soda Metasomatism

This phenomenon, which is widespread in the Southern Structural Province, has been of interest to this office for several years. For a review of the previous work the reader should refer to Meyer et al. (1986, 1987, 1988, and 1989). A description of the distribution, geology, geochemistry, and related mineral occurrences within the Wanapitei Lake area, northeast of Sudbury, can be found in Gates (1991).

Soda metasomatism is known to affect Sudbury-type breccias (1850 Ma), and olivine diabase dikes (1250 Ma) locally cut the alteration. This suggests an age in the range 1250–1850 Ma. The geochronology of soda metasomatism in the Sudbury-Wanapitei Lake area is currently being studied by Schandl, Davis, and Gorton, at the Royal Ontario Museum as part of the Ontario Geoscience Research Grant program. The objectives of the study are fourfold: 1) to determine the age of the soda metasomatism, 2) to determine the age of gold mineralization associated with chlorite alteration, 3) to identify the alteration associated with gold mineralization, and 4) to compare rare-earth-element concentrations of unaltered host rocks with soda metasomatised and chloritized equivalents. An uranium-lead date of 1699 ± 4 Ma has been obtained from hydrothermal monazite crystallized during soda metasomatism in a rock sample from the Wanapitei Lake area (E. Schandl, Royal Ontario Museum, personal communication, 1991).

After a review of available literature, several occurrences suspected of being related to soda metasomatism were varified in the field.

Along the north shore of Evangeline Lake in McKinnon Township, the Bob Tough and Pit Island gold showings are both associated with soda alteration. Both properties are located in Serpent Formation arkose which has been albitized and contains associated ankerite, chlorite, and hematite alteration. Mineralization consists of white to black quartz with pyrite and arsenopyrite mineralization is best associated with the albite.

To the east in Mongowin Township, the McMillan Mine is located within Gowganda Formation near the contact with the Lorrain Formation and near the northwest-trending McMillan Fault. The property produced 10593 ounces of gold from 60139 tons of ore mined from 1934 to 1937. Gold is associated with quartz veins near feldspathic sandstone-pelite and feldspathic sandstone-amphibolite contacts.

A brief visit was made to the property in 1989 looking for evidence of albitization. Nothing obvious was observed except for one sample from the muck pile which contained ankerite rhombohedra, mineralization that is often associated with, or distal to, zones of soda alteration.

Whole rock analyses for 33 samples collected from the McMillan Mine as part of the Precious Metal Study: Sudbury–Espanola Area are now available. Numerous samples contain Na_2O values in the 5 to 6% range. The highest value for Na_2O is 6.89% from a feldspathic quartzite, which hosts a quartz stockwork comprised of 72.5% SiO_2. This could translate into a rock containing 58% albite and about 30% quartz if all the soda is used to form albite. Several rocks with lower Na_2O values, in the 3 to 4% range and SiO_2 values in the 80 to 84% range, may also indicate a high degree of pervasive alteration. Similar values from Lorrain Formation quartzite in the Wolf Lake area reflect a complete replacement of the original sericitic matrix by albite. These rocks are associated with quartz veins, hematization, chloritization, and gold and copper mineralization.

Four samples of carbonatized gabbro or amphibolite (2.01% CO_2), were found to contain twice the Na_2O values (1.76% vs. 0.89%) as compared to non-carbonatized gabbro (0.32% CO_2).

Do these Na_2O values reflect high soda associated with the original rock chemistry, or are they related to a later, visually unrecognizable, metasomatic event?

Approximately 3 km east long Highway 6, albitization trends northeast paralleling the Fox Lake Fault. An irregular zone up to 150 m wide southeast of Fox Lake contains associated breccias and quartz-carbonate veins with minor gold mineralization. Immediately north, albite veins 10 to 50 cm wide are located in visually unaltered Gowganda Formation paraconglomerate. Continuing north, the albite veins yield to quartz veins with albite halos and eventually quartz veins devoid of albite.

Two gold showings on Stratton Lake, in Merritt and Foster townships, contain sulphide mineralization associated with quartz veins along the Loon Lake Fault. No soda alteration was observed at these showings but albitization and silicification associated with this fault occur along Highway 6, 2.4 and 3.0 km west of the two showings. Quartz veins and the associated sulphide mineralization may reflect silica and minerals leached by albitization and deposited distal to the main alteration zone.

At the Howry Creek prospect in Curtin Township gold is associated with arsenopyrite in a quartz vein within feldspathic sandstones of the Gowganda Formation. A total of 32 rock samples from the Howry Creek prospect were analayzed for the Precious Metal Study: Sudbury-Espanola Area. Greater than half the samples contained Na_2O values in the 5 to 7% range with correspondingly low K_2O values. One sample described as a light grey, fine-grained quartzite with rusty iron-carbonate patches assayed 10.5% Na_2O. This approaches the composition of pure albite that can contain a maximum of 11.83% Na_2O.

The author observed quartz veining and arsenopyrite mineralization in association with albite, near the contact between sandstone and a narrow greywacke unit. Pervasive hematization is associated with the sandstone south of the main showing. Albitization also occurs on the adjoining property to the north, held by D. Brunne and R. Stringer, along the contact between Nipissing gabbro and Gowganda Formation greywacke (Cosec 1991).

Table 16.3 contains information regarding the field visits conducted in 1991 by staff of the Sudbury Resident Geologist's office.

RECOMMENDATIONS FOR EXPLORATION

Exploration for base metals in the Benny greenstone belt was relatively low in 1991, despite the release of an airborne geophysical electromagnetic survey by the Ontario Geological Survey. Much of the ground with good mineral potential has been claimed in previous years, although the two western townships remain unexplored. The metavolcanic rocks of Hotte and Gilbert townships remain to be mapped or studied in detail and merit reconnaissance exploration.

North and east of the Benny greenstone belt, inliers of metavolcanic rocks also show some potential for base-metal mineralization.

In the area regionally mapped as the Cartier Batholith, new logging roads have recently been constructed by E.B. Eddy Forests Products Limited. Along one such road in Marquette Township near Battersby Creek, an outcrop area

Table 16.3. Field visits, 1991.

Number on Figure 16.5	Name of Occurrence; Commodity Sought	Owner
1	Kidd Copper; Ni, Cu	Town of Walden
2	Wikwemikong dolomite; dolo	Manitoulin Island Unceded Indian Reserve 26
3	Shakespeare-Dunlop; PGM	B.P. Can. Res.
*4	East Bull Lake; PGM	E. Gallo
5	Positano Prospect; stone	J. Positano(?)
6	Erana Mines Quarry; stone	Int. Larder Mins.
7	Dana Black Quarry; stone	C. Larcher
8	Rauhala Prospect(?); Au, Ni, Cu	J. Rauhala
9	Jarvis Quarry; stone	Jarvis Res.
10	St. Charles Prospect; stone	Manex/Canital Granite
11	*Holstrom Prospect; Pb, Zn*	*BLM Mines*
12	Central Hess; Pb, Zn, Ag	BLM Mines
13	Golden Rose Mine; Au	Noramco(?)
14	Fraser Mine; Cu, Ni	Falconbridge Ltd.
*15	Yorkston River; Fe	Crown
16	Moose Mountain Mine; Fe, Zn	R. Gervais
*17	*Chief Lake; Au*	*T. Hanninen/A. Maki*
*18	Brady Prospect; stone	J. Brady
19	Venetian Lake; Pb, Zn	S. Stromsholm
*20	Battersby Creek; Au, ?	A.Maki/T.Hanninen
21	Mirage Project; Base metals	Falconbridge Ltd.
22	Boulanger Occ.; Au	J.D. Bradley
23	Rathbun Lake; Au, Ni, Cu, PGM	Flag Resources (1985) Ltd.
24	French River; nephelene	K and E Sand and Gravel Sarnia
25	Silver Lake; limestone (hazard)	
26	Meldrum Bay; dolo	Standard Aggregates
27	Hanmer; aggregate	MNR
28	Manitoulin Island; limestone, dolo, various oil, nat.gas	
29	*Sims Occurrence; garnet*	*W. Sims*
*30	Brunne Prospect; PGM	D. Brunne/R. Stringer
31	Bob Tough/Pit Island; Au	E. Stringer
32	Stratton Lake; Au, Cu	Crown
33	Howry Creek Mine; Au	A. Elliott
34	*Challew Occurrence; Au, Cu*	*G. Salo*
35	*Salo Occurrence; Ni, Cu*	*G. Salo*
36	Shakespeare Gold Mine; Au	
37	Kelly Prospect; Cu	Crown
38	Little Penage Lake, Na-alteration	
39	*Copenhagen Mine; Cu, Pb, Zn*	*T. Miron/W.Thibeault*
40	Richardson Lake Occ., Na-alteration	
*41	Salo Occurrence; Cu	G. Salo

*Indicates new occurrence
Occurrences explained in Property Visits section

approximately 1 km wide was identified as an altered mafic intrusion. A grab sample from a zone of intense epidotization with finely disseminated pyrite, 0.9 m wide, assayed 0.03 ounce Au per ton. Platinum group metal assays have yet to be returned at the time of writing. Structural relationships with other late mafic intrusives in the area (ie. dikes) indicate that this intrusion may be of Archean age, and possibly coeval with the platinum group metal-bearing East Bull Lake and Shakespeare-Dunlop layered mafic intrusions. The mafic intrusion in Marquette Township appears itself to be intruded by three distinct varieties of post-Archean dikes. Outcrop exposure in the area is good, and the potential for locating similar rocks is excellent. The area of search theoretically extends from north of Agnew Lake to Biscotasing Lake.

Quartzites of the Lorrain and Mississagi formations that are in contact with, or as inclusions within, felsic batholiths associated with Grenville Front metamorphism were examined during the field season. These units were often found to be extremely siliceous, auriferous, and low in impurities. Exploitation for use as metallurgical smelter flux may be economical if sufficient tonnages can be delineated.

Interest in dimension stone was high in 1991, but most prospects appear unsuitable for development primarily due to the intensity of fracturing. Dimension stone prospectors are encouraged to carefully examine the fracture patterns of large outcrop areas prior to expending funds for stone promotion. Felsic and anorthositic intrusions as well as banded gneisses south of the Grenville Front should continue to be considered as potential areas for dimension stone. Granitic and associated rocks of the Cartier Batholith, north of the Grenville Front, have recently become more accessible due to logging road construction. As mentioned earlier, prospecting for either metals or dimension stone in this area is warranted.

RESIDENT GEOLOGIST'S STAFF AND ACTIVITIES

Staff

The following staff were assigned to the Sudbury Resident Geologist's office in 1991.

1. M. Cosec, Acting Resident Geologist. M. Cosec was the Acting Resident Geologist from September, 1990 to the end of October, 1991.
2. T. Livingstone, secretary.
3. B.I. Gates, Staff Geologist. B.I. Gates was on contract from January to December as a Staff Geologist.
4. M. Williams, Experience '91. M. Williams, hired through the Experience '91 program from June through August, was a field assistant to B.I. Gates and M. Cosec.
5. W. Meyer returned to his position of Resident Geologist from his secondment in late 1991.

Activities

Staff of the Resident Geologist's office responded to over 1280 inquiries regarding sample identification, assessment work, mineral occurrences, mineral potential, geology of the area and government programs. Staff offered advice and assistance to property owners both in the office and in the field, and the year 1991 experienced the highest number of client inquiries in over a decade.

The staff also guided several geological tours, dimension stone tours, gave oral presentations to a variety of audiences and prepared and presented displays at several public functions, a few of which area as follows.

In March, staff attended several lectures during the Prospectors and Developers Association Convention in Toronto.

In April, staff participated in the Northeastern Region Mineral Resources Symposium in Kirkland Lake. The poster display was entitled "Exploration and Mining Activity in the Sudbury Resident Geologist's Area—1990".

In late April and early May, the Resident Geologist's office presented another 18 hour series of prospector classes. Ministry of Northern Development and Mines (MNDM) staff who assisted with the classes included M. Cosec, V. Miller, D. Constable, W. Meyer and B.I. Gates. Facilities were provided free of charge by Cambrian College. M. Sweeny, Falconbridge Limited, Robert Komarechka, Bedrock Consulting; and Ed Pattison, Inco Limited volunteered their time to instruct the class. M. Cosec wishes to acknowledge the assistance of those who contributed to the success of the course.

M. Cosec guided several geological tours of the Sudbury Basin and surrounding area for a number of individuals and groups including E.B. Eddy Forest Products Limited staff. Dimension stone tours were numerous this summer. As well as for MNDM staff, tours were conducted for a group of Italian delegates, a group of British delegates, J. Melo of Allstone Quarry Products Limited, local prospectors, and out-of-town geologists.

Several office tours were given to out-of-country delegates, including representatives from Brazil, China, Chile, Ecuador, Great Britain, Italy, and Finland. Several colleges and high school groups from southern Ontario visited the office as well.

On September 25, M. Cosec and B.I. Gates guided a group of geography teachers on an MNDM-sponsored aerial tour of the Sudbury Basin. This one hour flight is an annual event that is part of a week long tour organized by B. Campbell of the Ontario Mining Association. The Association offers 40 geography teachers, primarily from southern Ontario, the opportunity to visit northern Ontario mining communities. The tour includes Timmins, Kirkland Lake, Cobalt, and Sudbury. In addition to the aerial tour, the teachers also participate in an underground tour of one of Sudbury's many mines. It has been shown that the teachers return to their classrooms with a better understanding of the unique advantages and disadvantages of northern Ontario and are able to pass on to their students their positive experiences and appreciations. The interest was so great this year that a fourth flight from the Ministry of Natural Resources was requested.

In December, M. Cosec and B.I. Gates presented an "Exploration Activity—1991" poster display in the 1991 Ontario Mines and Minerals Symposium in Toronto.

M. Cosec delivered a talk to Chelmsford Valley and District High School on Environment Day concerning "The Impact of Mineral Exploration and the Environment".

M. Cosec attended the Geological Association of Canada (GAC)-Mineralogical Association of Canada (MAC)-Society of Economic Geologists (SEG) annual meeting in May in Toronto. He also participated in a week long Huronian field trip hosted by the GAC-MAC-SEG.

M. Cosec delivered a talk to the Georgian Bay Association conference on the mineral potential of the Georgian Bay–Lake Huron North Shore area.

M. Cosec and B.I. Gates participated in the Sudbury Gem and Mineral Show again this year. There was much interest in the display which featured our office services and fossil collecting localities, book raffles, and free ore specimens (donated by Inco Limited).

B.I. Gates created a geological display for the Providence Bay Interpretive Centre on Manitoulin Island. It features the many rock types, fossils, and other interesting geological features of the area.

In August, M. Cosec presented a talk and conducted a field trip in Killarney Provincial Park for approximately 80 people.

The Sudbury Resident Geologist's office accepts donated diamond-drill core from properties of geological significance from within the district. The core is stored outside at the Ontario Government Complex at McFarlane Lake. In 1991, approximated 6100 m of core were accepted from the Fostung scheelite occurrence by Noramco Mining Corporation, and approximately 5000 m from the Shakespeare-Dunlop mafic intrusion by B.P. Resources Canada Limited. In order to access the core, contact the Sudbury Resident Geologist's office.

The first phase of the Geoscience Exploration Database (GED) program was completed in March, 1991. Data assimilation was done by Bedrock Consulting, of Sudbury. A total of 984 new and updated files were completed, while approximately 200 remaining files will be added early in 1992.

Precious Metal Study: Sudbury Espanola Area—Epilogue

This project was initiated in 1985 as a two year project to study precious metal occurrences in the Sudbury–Espanola area. The majority of the properties are located south of Espanola in a west-trending zone which extends approximately 30 km through McKinnon, Mongowin, Curtin, and Roosevelt townships. The purpose of the study was to examine, map, sample, and interpret the geology of known gold prospects and former producers found within parts of the Huronian Supergroup.

Gold was first discovered in the area around 1903, and four of the properties examined were small producers at various times during the early 1900's and 1930's. For a more complete description of the project see Meyer et al. (1986, 1987). The following is a list of the properties examined:

1. Evangeline Lake Area
   a) Pit Island
   b) Bob Tough Prospect
2. Lordan Occurrence
3. McMillan Mine
4. Fox Lake Prospect
5. Upsala Mine
6. Bousquet Mine
7. Howry Creek Mine
8. Bridger Occurrence
9. Hanwood–Leech Lake Area
10. Platinum Occurrence
11. Majestic Prospect
12. Jo-Ami
13. Stratton Lake Occurrences
14. Shakespeare Mine
15. Long Lake Mine

A file containing the available information for each property is now available for viewing in the Sudbury Resident Geologist's office. A mylar geology map at a scale of 1 inch to 100 feet, an overlay showing sample locations, and a coloured paper copy of the geology is on file for each property.

Geochemical analyses are available for the McMillan Mine and Howry Creek Mine properties.

OGS ACTIVITIES

M.C. Rogers mapped and studied the geology of the Whiskey Lake area, districts of Algoma and Sudbury.

RESEARCH BY OTHER AGENCIES

A.J. Naldrett, University of Toronto, has been studying the platinum-group metals, nickel, copper, cobalt, and gold variation in Sudbury North Range ore shoots through funding provided by an Ontario Geological Research Grant (OGRG).

E.S. Schandl, and D.W. Davis from the Royal Ontario Museum, and M.P. Gorton, University of Toronto, are studying the geochronology of sodium metasomatism in the Sudbury–Wanapitei Lake area, through funding by an OGRG.

The structural and stratigraphic setting of the Errington and Vermilion zinc-copper-lead massive sulphide deposits in Sudbury, Ontario was investigated by J. Paakki and H. Gibson of Laurentian University, and M. Gray of Falconbridge Limited. Funding was provided by an OGRG.

R.E. Whitehead and J.F. Davies of Laurentian University studied the lithogeochemical variations at the sedimentary Onaping-Onwatin Contact (OGRG funding). The hypothesis that the ore-forming system responsible for the mineralization is linked to the underlying Sudbury Igneous Complex will be tested.

The southwestern extension of the South Range shear zone, Sudbury Structure was investigated by T.L. Little and D.H. Rousell of Laurentian University (MRGP).

A.P. Dickin, McMaster University, conducted Os and Pb isotope investigations of Sudbury ores and their possible crustal sources.

Platinum-group-metals mineralization in the marginal rocks of the East Bull Lake gabbro-anorthosite intrusion was investigated by D.C. Peck, P.T. Chubb and R.S. James of Laurentian University (MRGP).

A lithogeochemical study of the archean metavolcanic rocks of the Whiskey Lake greenstone belt was conducted by M. Byron and R.E. Whitehead of Laurentian University.

Geological investigations were conducted at the Sheguiandah archeological site on Manitoulin Island by P.J. Barnett, Ontario Geological Survey, P. Julig, Laurentian University, and P. L. Storck, Royal Ontario Museum.

C. Marmont, under the Northern Ontario Development agreement, commenced a study to investigate industrial minerals and building stone potential in central and northern Ontario.

LITHOPROBE, the five-year multidisciplinary study of the Earth's crust, held two sessions in Sudbury in 1991. Unfiltered seismic reflection data from the Sudbury transect was released early in the year, and has been made available for viewing at the Sudbury Resident Geologist's office. A two-day workshop held in June discussed geometric conceptions related to the Sudbury Structure. Results were presented at the Ontario Mines and Minerals Symposium in December.

Development work at the Sudbury Neutrino Observatory continued throughout the year. Located on the 6800 foot level of the Inco Limited Creighton No.9 Mine, this laboratory will be used to examine particles called neutrinos that are emitted from the centre of the Sun and exploding stars. They are the only particles that emerge directly from the thermonuclear furnaces at the core of stars and are considered to be the fundamental building blocks of nature. Neutrinos pass directly through the Earth, but some will interact with the subatomic particles of heavy water. The Sudbury Neutrino Observatory will be built in a cavern as large as a 10 story building, in which an enormous acrylic bottle will hold 1000 tons of radiation-free heavy water. When the neutrinos pass through the heavy water, flashes of light are produced that will be monitored by a gallery of detectors. Researchers will be able to detect their energy, direction, and speed; factors which have previously never been measured. The laboratory is being built at a cost of $61 million and is scheduled for completion in 1995 (Inco Limited, Public Affairs Department).

Atomic Energy of Canada Limited released files of their research in the East Bull Lake area. Much of this previously confidential work was conducted in the last ten years. Technical reports and microfilm are now available for viewing at this office.

ACKNOWLEDGMENTS

The authors wish to thank T. Livingstone for assistance in manuscript preparation and poster display production for the Mines and Minerals Symposium.

B.I. Gates authored examinations of property visits of W. Sims, G. Salo, and the Copenhagen occurrence, and the section on soda metasomatism. His assistance with poster displays throughout the year was appreciated.

R. Stewart provided technical drafting assistance.

SELECTED PUBLICATIONS RECEIVED

The Sudbury Resident Geologist's office has available the most recent issues of the following periodicals: *The Northern Miner, Northern Miner Magazine*, and *Dimensional Stone Magazine*.

Listed below are books received by the office in 1991. Other books and peiodicals are available to the interested reader for viewing at the office.

1991. Program with Abstracts, Volume 16; Toronto 1991 Geological Association of Canada-Mineralogical Association of Canada Joint Annual Meeting with Society of Economic Geologists, May 27–29, 1991.

Bryon, M. and Whitehead, R.E. 1991. Lithogeochemical Study of the Archean Volcanic Rocks of the Whiskey Lake Greenstone Belt, Algoma District; Ontario Geological Survey, Open File Report 5814, 20p.

Ferris, F.G., Beveridge, T.J., Fyfe, W.S., Mann, H., Tazaki, K., Kerrich, R. and Wiseman, M. 1991. Retardation of Toxic Heavy Metal Dispersion from Nickel-Copper Mine Tailings, Sudbury District, Ontario: Role of Acidophilic Micro-organisms; Ontario Geological Survey, Open File Report 5742, 15p.

Gates, B.I. 1991. Sudbury Mineral Occurrence Study; Ontario Geological Survey, Open File Report 5771, 235p.

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Marmont, C. 1991. Industrial Minerals and Building Stone in the districts of Nipissing, Parry Sound and Sudbury; *in* Summary of Fieldwork and other Activities 1991, Ontario Geological Survey, Miscellaneous Paper 157, p.276–279.

Peck, D.C. and James, R.S. 1991. Geology and Platinum Group Element Sulphide Mineralization, East Bull Lake; Ontario Geological Survey, Open File Report 5813, 65p.

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Rogers, M.C. 1991. Precambrian geology of the Whiskey Lake area, east half; Ontario Geological Survey, Open File Map 178, scale 1:15000.

Young, G.M. 1991. Stratigraphy, Sedimentology and Tectonic Setting of the Huronian Supergroup; Geological Association of Canada-Mineralogical Association of Canada-Society of Economic Geologists, Joint Annual Meeting, Toronto '91, Field Trip B5: Guidebook, 34p.

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Marmont, C. 1991. Industrial Minerals and Building Stone in the districts of Nipissing, Parry Sound and Sudbury; *in* Summary of Fieldwork and other Activities 1991, Ontario Geological Survey, Miscellaneous Paper 157, p.276–279.

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17. Field Services Section, Southern Ontario: Introduction

A.E. Pitts

Regional Manager, Field Services Section (South), Ontario Geological Survey – Information Services Branch

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The Southern Ontario Region is the main source of Ontario's structural materials, such as sand, gravel, crushed stone, clay, shale, calcined lime and building stone; and also industrial minerals such as salt, gypsum, nepheline syenite, talc, silica, and gemstones. Mineral production values for 1991 in Southern Ontario are expected to be similar to last year's values. Commodities such as cement, gypsum, talc and shale continued to be affected by lower demands in the construction industry. Exploration activity was at its lowest level in more than ten years. The total man-days of assessment work was down to 6730 (to November 1, 1991) as compared to 30804 in 1990. Most of the grass-roots exploration activity that did take place, was funded under the Ontario Prospectors Assistance Program and the Ontario Mineral Incentive Program. There was a continuing interest in graphite, building stone, flagstone, silica, gold, platinum, base metals, and high-purity limestone.

Upper Canada Stone Company Limited opened a new quarry in Mayo Township. The company crushed 16000 tonnes of white silicious dolomitic marble this year with plans to increase their production to 50000 tonnes in 1992. I.K.O. Industries Limited began developing their new quarry in Madoc Township in order to produce granules for their roofing materials plant in Brampton. Domtar Incorporated began mining gypsum from their No.3 mine at Caledonia in the spring. Brampton Brick began extraction of Queenston shale from their Cheltenham pit and were in full production in 1991. Northern Excavating Novar Inc. has opened a quarry in Perry Township in order to produce flagstone and crushed granite.

The Southern Ontario Region has three Resident Geologists' offices. These offices are located in London, Dorset and Tweed. Resident Geologists provide a professional advisory service on the geology and mining activity in their Districts. They also offer assistance in local resource development and provide advice on land hazards and on land-use planning.

The Region also has an office in Bancroft, which is managed by H. Meyn, a regional specialist. In 1991, H. Meyn continued his detailed mapping (1:5000) in Madoc Township in the vicinity of Rimington and in Belmont Township in the area northeast of Belmont Lake. The Bancroft office provides advice on local geology, mineral collecting and mining activities.

The Region has two drill core libraries which are located in Tweed and Bancroft. Relevant drill-core reference material is obtained from mineral exploration programs in the area and is logged and indexed for ready access by clients. There were 45 visitors to these facilities this year.

Field staff were involved in a number of projects during 1990. D. Villard initiated a program of deep lake sediment drilling in the Huntsville area in order to provide new information about geochemical controls on the distribution of mercury and associated elements. C. Marmont undertook an industrial minerals assessment project in parts of Central Ontario under the Northern Ontario Development Agreement which was signed in 1991. B.H. Feenstra and R.I. Kelly continued with their work on a number of projects in Southwestern Ontario including overburden drilling to evaluate aggregate potential in McGillivray Township and subsurface stratigraphy in Beaver Valley; evaluation of Southwestern Ontario Paleozoic carbonate resources for various industrial applications; a Quaternary geological investigation of the Woodbridge ANSI; and the assessment of mineral resource potential of the Lake Simcoe area including building stone, cement, high-purity calcium carbonate and high-specification aggregate. P.S. LeBaron completed OFR No. 5808 entitled "Exploration for Gold in Southeastern Ontario, 1980-1990". He also developed a field trip guide compilation for this area. P.W. Kingston conducted a feasibility study on the beneficiation of sillimanite from Eastern Ontario. A high-aspect-ratio sillimanite product would have potential applications as a functional filler in plastics and as a reinforcing component in ceramic composites. P.W. Kingston and W.F. Caley (Technical University of Nova Scotia) started the potential application of industrial minerals in ceramic and metal matrix composites.

The three District offices completed the input of mineral occurrences into an on-line computer database known as the Mineral Deposit Inventory. These data are accessible at these offices.

18. Algonquin Resident Geologist's District—1991

D.J. Villard[1], R. Keevil[2] and C. Marmont[3]

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[2]Geologist, Dorset, Field Services Section, Ontario Geological Survey – Information Services Branch

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INTRODUCTION

Exploration activity in the Algonquin Resident Geologist's District continued at levels similar to those of the past few years, although the number of claims recorded was down from 156 in 1990 to 81 "claim units" in 1991. Exploration for base and precious metals continued throughout the district, while activity for building stone was concentrated in the western part of the district. Interest in flagstone has undergone a steady increase over the past 4 years, a little surprising considering the downturn occurring within the construction industry.

Cal Graphite Corporation continued production from its graphite property which is situated northeast of Huntsville. The company anticipates achieving full production levels by the first quarter of 1993.

In April, a project was initiated to evaluate the economic potential of industrial minerals in central Ontario. This program falls under the Northern Ontario Development Agreement (NODA) signed in November, 1991.

Public education continues to be an important function of the Dorset-based Algonquin Resident Geologist's office. As well as providing outreach educational activities throughout the district, the office is responsible for delivering geoscience education programs at the Leslie M. Frost Natural Resources Centre at Dorset.

MINING ACTIVITY

Cal Graphite Corporation

Cal Graphite Corporation continued a program marked by steady production growth that had reached 17 short tons of graphite flakes per day by December, 1991. This company is still in a start-up phase, and full production levels are not expected until the first quarter of 1993. The company is currently involved in a major capital expenditure program to fund this start up as well as to increase production levels and product quality. An independent consulting engineering firm was retained to review Cal Graphite Corporation's reserve position and assist in developing a long range mining plan.œ

Cal Graphite Corporation has acquired a facility in Huntsville, Ontario, which will be used immediately as inventory warehouse space; additionally, this facility could be used in the future for product finishing. The company feels that its product is achieving strong acceptance in the marketplace, mainly due to the high quality and consistency of the flake.

Stone Quarries

Throughout the district, 30 quarries produce stone for either the aggregate or construction industry. Of these, there are 18 which produce crushed stone and 12 which produce stone for an assortment of products, such as flagstone, landscaping stone and masonry stone.

Most notable among the flagstone producers is the Mill Lake Quarry located in Parry Sound. This quarry operates during the nonwinter months and produces a selection of flagstone products, with thicknesses ranging from 0.5 to 4 inches. Colours vary between shades of pink and grey. The quarry employs 6 full-time employees plus a few part-time workers.

A limited amount of work was done by Amsen Quarries at the McFadyen Quarry, Franklin Township.

Fowler Construction Ltd. developed the Lehman Quarry, in Sinclair Township, primarily as a source of landscaping stone. The stone is particularly suitable for use as steps and as stackable blocks for use in retaining walls, in addition to being a well- known flagstone and veneer stone.

Northern Excavating Novar Inc. has opened a quarry in Perry Township to produce flagstone and crushed granite.

Other Quarries

The Blue Star Mine, in Chapman Township, continued to provide tourists and mineral collectors with an opportunity to collect amazonite, smoky quartz and garnet from a pegmatite vein occurring on the property. The mine and adjacent "rock shop" are open to the public daily from 10:00 a.m. to 4:00 p.m. during the summer and on weekends in the spring and fall. The mine employs 3 full-time staff and 1 donkey. Jewellery and mineral specimens obtained from other localities may be purchased at the "rock shop".

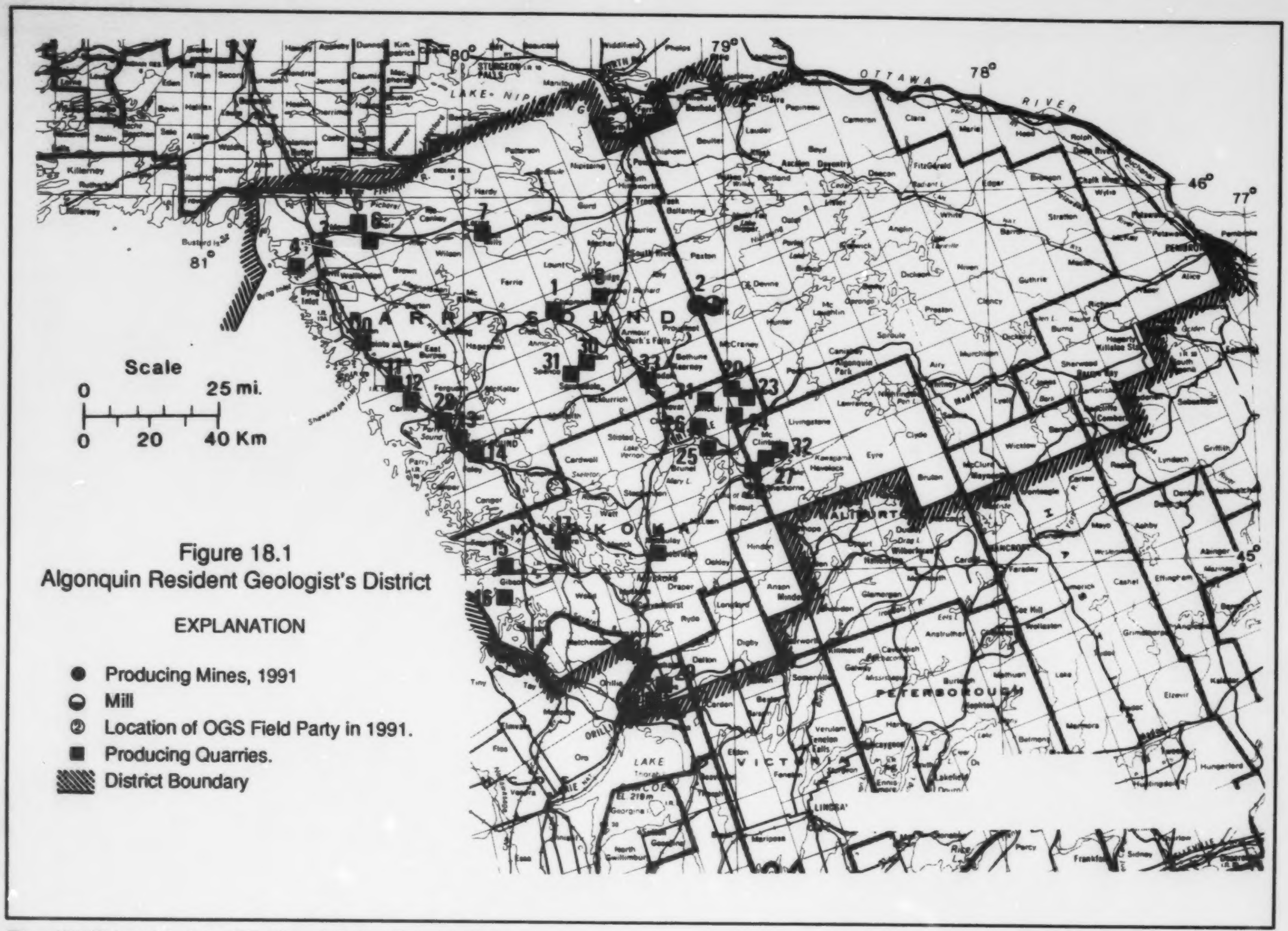
Figure 18.1
Algonquin Resident Geologist's District
EXPLANATION
● Producing Mines, 1991
◒ Mill
② Location of OGS Field Party in 1991.
■ Producing Quarries.
▨ District Boundary
Scale
0
25 mi.
0
20
40 Km
81°
80°
79°
78°
77°
46°
45°
OTTAWA
RIVER
LAKE NIPISSING
STURGEON FALLS
PARRY SOUND
MUSKOKA
HALIBURTON
PETERBOROUGH
VICTORIA
LAKE SIMCOE
1
2
3
4
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11
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Figure 18.1. Mining activity during 1991, Algonquin Resident Geologist's District.

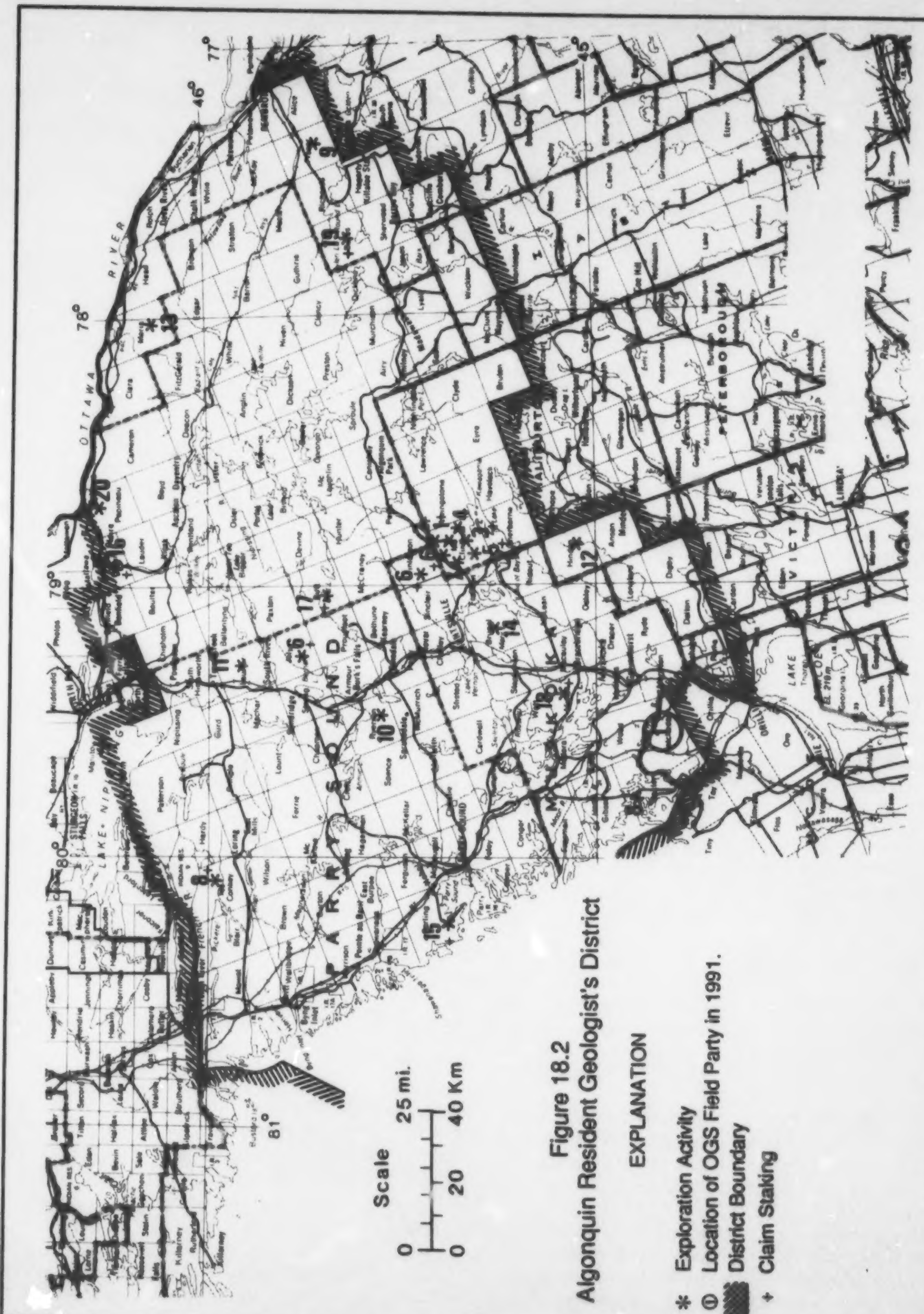
Figure 18.2
Algonquin Resident Geologist's District
EXPLANATION
* Exploration Activity
① Location of OGS Field Party in 1991.
▨ District Boundary
+ Claim Staking
Scale
0 25 mi.
0 20 40 Km
OTTAWA RIVER
LAKE NIPISSING
PARRY SOUND
PETERBOROUGH
HALIBURTON
VICTORIA
LAKE SIMCOE
81°
80°
79°
78°
77°
46°
45°
1
2
3
4
5
6
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Figure 18.2. Exploration activity during 1991, Algonquin Resident Geologist's District.

In McClintock Township, a quartz quarry is being worked on an intermittent basis to produce white quartz that is used primarily in landscaping. The deposit occurs in a quartz-rich, zoned pegmatite which is characteristic of many of the pegmatites found in the area. The holder of this aggregate permit has plans for expanding the operation and increasing production.

Mining activity is shown on Figure 18.1 and listed in Table 18.1.

ADVANCED EXPLORATION AND DEVELOPMENT

To the knowledge of staff of the Algonquin Resident Geologist's District, no advanced exploration had occurred in the district during 1991.

EXPLORATION ACTIVITY

As of December 1, 1991, a total of 81 claim units had been staked in the Algonquin Resident Geologist's District. This is a marked reduction from previous years, although exploration activity remains at levels similar to the past several years. Although not as many new properties were acquired in 1991 as compared to previous years, work did continue on many of the existing properties. Activity was concentrated on interests in building stone, flagstone, graphite, marble, precious and platinum group metals and base metals.

Industrial Minerals

BUILDING STONE

There has been a continuing interest in dimensional granite and gneissic flagstone occurring in the district. Flagstone, in particular, has been a focus of significant exploration activity during 1991, in spite of the economic recession.

Central Ontario Natural Stone Ltd. of Orillia has staked claim units in Finlayson, Joly and McClintock townships. They plan to extract both flagstone and larger stone suitable for guillotining. Staking was necessary because of the Ontario Ministry of Natural Resources' refusal to issue an aggregate permit until the Algonquin Provincial Park Master Plan has been approved.

E. and B. Wickern have stripped an area of potential dimensional granite in Ryerson Township. Tiles cut from this site are an attractive dark grey to black-coloured gneiss with crosscutting red- and white-coloured veinlets.

Several companies are continuing to explore in the western part of the district for good sources of dimensional granite. A view is held by these companies and by the authors that some of the gneisses have good demand potential should they be traded on the world market for this commodity.

Table 18.1. Mining Activity 1991, Algonquin Resident Geologist's District.

Number on Figure 18.1.	Company/Mine/ Individual	Commodities
1	Blue Star Mine	pegmatite, amazonite, quartz, garnet
2	Cal Graphite	graphite
3	M.T.O.	crushed stone
4	M.T.O.	crushed stone
5	M.T.O.	crushed stone
6	M.T.O.	crushed stone
7	M.T.O.	crushed stone
8	M.T.O.	crushed stone
9	Fowler Construction	crushed stone
10	M.T.O.	crushed stone
11	M.T.O.	crushed stone
12	M.T.O.	crushed stone
13	Maclaim	crushed stone
14	M.T.O.	crushed granite
15	M.T.O.	crushed granite
16	M.T.O.	crushed granite
17	M.T.O.	crushed granite
18	Robert Fleming	crushed granite
19	Fowler Construction	crushed limestone
20	Tasso Lake Stone	granite gneiss, white quartz
21	Rockwood Quarries	granite gneiss, flagstone
22	John Bacher Construction	granite gneiss, flagstone
23	McDonald Quarry	granite gneiss, flagstone
24	Fraser Quarry	granite gneiss, flagstone
25	Huntsville Quarry	granite gneiss, flagstone
26	Lehman Quarry	granite gneiss, flagstone
27	International Quartz Ltd.	white quartz
28	Mill Lake Stone	gneiss
29	Rama Stone Quarries	red gneiss
30	Jeffery, A.R.	granite gneiss, flagstone
31	Ted Boyes & Sons	granite gneiss, flagstone
32	Sirius Landscaping	granite gneiss, flagstone
33	Northern Excavating Novar	crushed stone

Note: the abbreviation M.T.O., above, refers to Ontario Ministry of Transportation.

QUARTZ

Some interest has been expressed by prospectors by their exploring the quartz-rich pegmatites scattered throughout the district as possible sources of high-grade silica. To date, the quartz so hosted has been used mainly in landscaping.

GRAPHITE

A continued interest in finding and developing a high-quality graphite deposit is evident by the continuation into 1991 of exploration activity in the townships of Baxter and Laurier.

Table 18.2. Exploration Activity 1991, Algonquin Resident Geologist's District.

Number on Figure 18.2	Individual/Company	Activity
1	W. Ellerington	diamond drilling, geological mapping, geophysics
2	Rene Tougas	prospecting, trenching
3	Fred & Sherry Swain	prospecting, geophyics, geochemistry, diamond drilling
4	Floyd Jones	sampling
5	Earl McNaughtan	prospecting
6	R. Lashbrook	prospecting
7	W. Ellerington Jr.	prospecting
8	Fred Atkinson	prospecting, geochemistry, geological mapping, trenching
9	James Lee	prospecting
10	Bert & Alwine Wickern	prospecting, stripping
11	Bruno Manella	prospecting
12	David Jennings	prospecting
13	R. Blais	prospecting
14	J. Irving	prospecting
15	J. Trusler	prospecting
16	D. Rose	prospecting
17	V. Sheehan	prospecting
18	R. Charron	prospecting
19	D. Recoskie	prospecting
20	A. Hennessy	prospecting

PRECIOUS AND PLATINUM GROUP METALS AND BASE METALS

Locations of exploration activity for base and precious metals were scattered throughout the district in 1991. Most of the work was carried out by local prospectors who tend to concentrate on one or two properties at a time.

McClintock Township, with 276 active claims, is the most active area in the district. Four prospectors (W.E. Ellerington, S. Swain, F. Swain and R. Tougas) continued to evaluate the copper, nickel and gold potential of the mafic and ultramafic intrusions on their various claim groups. Work performed on these various claim groups included geological mapping, diamond drilling, ground magnetometer and electromagnetic surveying, stripping, trenching and prospecting.

Exploration for gold remains limited with the 1991 activity that did occur having been distributed among the townships of McClintock, Ryerson, Laurier, Brunel and Baxter.

Exploration activity is shown on Figure 18.2 and listed in Table 18.2. Table 18.3 summarizes claim-staking activity and assessment work filed.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

The office is currently staffed by D. Villard, Resident Geologist, and J. Reed, Secretary. M. Garland, Staff Geologist, moved to Thunder Bay in April for an 18 month developmental secondment. R. Keevil was hired as the Acting Staff Geologist and will continue as such for the duration of the Staff Geologist's secondment. C. Marmont, Geologist, was hired to undertake an industrial-mineral assessment of parts of central Ontario and is supported by funding from the Northern Ontario Development Agreement signed in 1991.

D. Villard initiated a program of deep lake-sediment drilling in the Huntsville area in order to provide new information about geochemical controls on the distribution of mercury and associated elements. Several of the lakes in question are characterized by anomalously high mercury levels in the sport fish. All of the major active mines in the district, as well as many of the smaller stone operations, were visited by office staff. Staff also provided assistance to several companies and individuals interested in developing flagstone and/or dimensional stone properties as well as metallic-mineral prospects.

R. Keevil was active in our public education—public awareness program, delivering geological-information sessions to public schools, rock and mineral clubs, Junior Rangers and senior citizens. He also played a major role in the delivery of the mineral-education program at the Leslie M. Frost Natural Resources Centre in Dorset. Staff of both the Ontario Ministry of Northern Development and Mines and the Ontario Ministry of Natural Resources provided 4420 user opportunities at the centre where an opportunity is defined as 1 person participating in a half-day session. An additional 1234 opportunities were realized by the client

Table 18.3. Summary of Claim Units Recorded and Assessment Work Credit (Southern Ontario Mining Division)

Year	Claim Units Recorded	Claim Units Cancelled	Claim Units Active	Diamond Drilling (Man Days)*	Geophysical Surveys (Man Days)	Geological Surveys (Man Days)*	Other Work (Man Days)*	Total Man Days*
1982	354	617	1,115	9,546	8,372	481	8,927	27,326
1983	391	377	1,157	8,317	2,839	3,135	5,032	19,323
1984	555	498	1,254	9,928	23,500	322	3,786	37,536
1985	457	360	1,312	15,619	3,192	650	5,937	25,398
1986	744	426	1,579	15,829	3,623	3,843	9,304	32,599
1987	619	526	1,641	6,692	24,592	5,721	5,352	42,357
1988	982	404	2,255	17,643	24,345	2,284	10,087	54,359
1989	598	729	2,423	22,470	14,140	4,017	8,081	48,708
1990	431	613	1,938	7,690	9,980	2,112	11,528	31,310
1991[1]	147	377	1,708	422 (+$2,233)	1,980	1,629 (+$14,447)	5,952 (+$13,338)	9,983 (+$30,018)

[1] Data provided are for the portion of the year up to November 30, 1991.

* Dollar figures represent assessment credits subsequent to the passing of the new Mining Act.

groups instructing themselves. The Ontario Science Centre has lent lapidary equipment to the Leslie M. Frost Natural Resources Centre to help in the delivery of sessions.

J. Reed spent a considerable amount of time on the upgrading of our various mineral-resource data bases and did a remarkable job of dealing with our various client groups when the rest of the staff were out of the office.

The Geological Exploration Database (GED) project initiated in January, 1991, added information on approximately 800 rock and mineral occurrences within the Algonquin Resident Geologist's District to a computerized data base. Continuation of this work into the fall of 1991 has resulted in the addition of a further 100 sites. Paper and computer files now exist for most of the mineral occurrences in the district. Plans for 1992 call for the addition of more geological information to the computer data base and for research into means of retrieving base data.

C. Marmont initiated a library-research project to evaluate the gold and base metal potential of the high-grade metamorphic rocks within the Central Gneiss Belt of Ontario. This work will be continued in 1992 by office staff.

C. Marmont attended the 47th Annual Convention of the Marble Institute of America in Quebec City, October 14–16, 1991. Marmont assisted in manning the External Affairs and International Trade Canada booth which displayed material from Ontario and other provinces and visited quarries at Rivieres a Pierre, fabricating plants at Quebec (Granicor), Thetford Mines (Granirex) and St. Augustine (Granite Bussieres, Grani-Decor, Abressa).

R. Keevil and C. Marmont participated in a review of the geology of the that part of the Central Gneiss Belt exposed adjacent to Georgian Bay; this trip was led by N.G. Culshaw of Dalhousie University, Nova Scotia, who has completed a 3 year mapping program using funding obtained from the Canada–Ontario 1985 Mineral Development Agreement (COMDA), a subsidiary agreement to the Economic and Regional Development Agreement (ERDA) signed by the governments of Canada and Ontario.

R. Keevil and C. Marmont attended the annual Friends of the Grenville field trip led by L. Nadeau (Geological Survey of Canada) in the Huntsville area.

C. Marmont attended Industrial Minerals `91 which was held in Toronto during October 22–23, 1991.

R. Keevil attended a 3 day course on ground and airborne geophysical surveying which was presented at the Haileybury School of Mines, Haileybury.

PROPERTY EXAMINATIONS

Ryerson Township

Six claims previously prospected for gold are now being investigated for building stone and albite. An area of approximately 75 by 10 m has been stripped to expose gneisses occurring on a small hill which measures some 3 to 5 m in height.

At this site, the country rock consists of banded quartz-feldspar-hornblende gneiss with mafic bands and pods.

Crosscutting aplitic and granitic dikes and concordant sweats of various origins are present within the folding and shears of the gneisses. Joint spacing, ranging from 0.5 to 2.0 m, is present in several orientations (including horizontal). Some joints appear to have been "healed" by granitic material. A small block has been cut and polished into tiles and these tiles have received favourable comments from members of the stone industry.

Perry Township

Northern Excavating Novar Inc. has been investigating a variety of rocks on its property which is located in lots 2 and 3, Concession II, Perry Township. The bedrock consists of gneisses with some amphibolite inclusions and peridotite. Parallel layers of granitic gneisses strike almost north and dip vertically. Material is being considered for use as flagstone, landscaping stone, aggregate and road metal. Approximately 5000 t have been crushed for use as aggregate and concrete (personal communication with H. Brush, owner).

McClintock Graphite

As a follow-up to an airborne geophysical survey, a small electromagnetic (EM) anomaly has been located on lots 20 and 21, Concession XIV, McClintock Township. The owner reports 5699 ppm and 347 ppm Co from 1 soil sample and 321 ppm Co, 298 ppm Ni, and 312 ppm Cu in a rock sample. A small EM conductor was located on the ground, and subsequent trenching has exposed a metapelitic layer within the mainly granite gneisses. The metapelite contains feldspar, garnet, mica, quartz, sillimanite and medium- to coarse-grained graphite flakes which constitute 0 to 5 weight % of the host rock's mineralogy. A characteristic rusty weathering occurs both on the surface and throughout the rock. The thickness of the flat-lying body has been shown to be over 2.0 m; however, more work is required to determine the size of the deposit.

Chaffey Township

A previously unreported prospect has been located in Lot 20, Concession VIII, Chaffey Township. A pit 4.0 by 5.0 by 3.0 m deep has been partially filled in and is currently overgrown by vegetation. Approximately 10 to 15 t of material has been removed to an adjacent dump. These workings are perhaps 30 to 40 years old with little evidence of any recent disturbance.

The rock at this site comprises a mafic gneiss cut by a granitic pegmatite. The gneiss consists mainly of garnet, feldspar, hornblende and mica. Massive pods of mica occur within the body. The pegmatite dike is 1 to 2 m wide and contains red orthoclase feldspar, white and smoky quartz, mica, rutile and garnet. It is not known whether the mica, quartz or feldspar was the main commodity of interest.

Go Home Paragneisses

Within the Go Home domain of the Central Gneiss Belt, there lies a metasedimentary belt which can be traced for several kilometres northeast and southwest of Six Mile Lake Provincial Park. This area lies approximately 6 km east of Honey Harbour and 150 km north of Toronto on adjacent Highway 69. The belt comprises mainly paragneisses with pelitic to semipelitic gneisses, calc-silicate gneisses, marbles and quartzites.

Baxter Lake Resources Ltd. has been actively exploring a section of the belt in Baxter Township for several years. Trenching and geological mapping in 3 areas have just been completed. Medium- to coarse-grained graphite flakes are now exposed in a white to grey pelitic gneiss. The owner estimates 3 to 6 weight % graphite in a white to grey pelitic gneiss which may be continuous for 1300 to 1500 m along strike. Thicknesses are in excess of 50 m. Previous testing on the property for graphitic carbon by the Ontario Research Foundation has averaged 3.33 weight % graphitic carbon. A substantial thickness of white to grey misty marble has also been identified on the property. Elsewhere in the vicinity, wollastonite is present within the marble units.

It is not known at the present time how this belt fits into the local geological framework. As mapping is completed by Baxter Lake Resources, target areas will become evident.

Laurier Township Graphite

Prospects north of Sausage Lake in Laurier Township, originally investigated for gold, have been the site of extensive geophysical, trenching and sampling work since 1985. Subsequent to the compilation of the self-potential geophysical survey, 290 trench and grab samples from 3 zones were taken from the graphite-bearing schist. The owner reports an average combined grade of 2.73 weight % graphitic carbon with some massive graphitic lenses ranging from 9.15 to 39.13 weight % graphitic carbon. The graphite is present in fine flakes, however, the owner has reported larger flake sizes in adjacent drill holes. Presently, the property remains open for an option at which time it is suggested a diamond-drilling program be undertaken to prove grade and tonnage at depth.

RESEARCH BY RESIDENT GEOLOGIST'S OFFICE STAFF

Northern Ontario Development Agreement

Work commenced on April 1 on a program to investigate the economic potential of industrial minerals and building stone in central Ontario. The program falls under the Northern Ontario Development Agreement (NODA) which was signed on November 4, 1991. The agreement is a subsidiary of the

Canada—Ontario Economic and Regional Development Agreement (ERDA). Restricted to northern Ontario, the project area includes the districts of Parry Sound and Nipissing within the Algonquin Resident Geologist's District, and those parts of the Sudbury and Cobalt Resident Geologists' districts which lie south of the Grenville Front. The program has recently been described by Marmont (1991a, 1991b). In the time since the release of that report, small blocks (400 kg) of granite have been collected from Milne and Stewart townships between North Bay and Temagami in the Cobalt Resident Geologist's District. Another block was also obtained from the McBride Quarry in Sundridge. These were sawn into thin tiles and polished by Khouri Granite Ltd., Sudbury. Samples are available for viewing at the Resident Geologist's offices at Dorset and Cobalt.

Time did not permit a detailed survey of the Mulock Batholith. However, within Stewart Township, a broad area was noted within which small outcrops displayed only a single, widely spaced joint set. The same area contained a significant number of large boulders of the Mulock granite. The stone is fairly homogeneous within limits, being weakly to moderately deformed. The less-deformed parts exhibit slightly rounded, large crystals of pink feldspar within a finer-grained matrix composed of quartz, feldspar and biotite. More-deformed varieties are foliated or lineated. Sections sawn parallel to this lineation are gneissic in appearance, whereas sections cut perpendicular to the lineation resemble the undeformed granite. The stone appears to be sound and not porous. These initial observations indicate that the area warrants further investigation. Tiles cut from these sites are extremely attractive and, again, appear to be sound.

The McBride Quarry has been described previously by Marmont (1991a). A small block was extracted from the quarry for sawing and polishing tests. These tests showed that the stone is indeed susceptible to weathering as previously noted, and the fresh pink stone is altered upon weathering to a duller-pink colour. The colour change progresses inward from the surface of the stone, and so the aesthetic character is not a problem (This type of change, for example, is common in limestones). The weathering occurs preferentially along the foliation planes. Stones which have been used as veneer and have had time to weather (some local store fronts in Sundridge) are of a pleasing aspect, and their structural integrity does not appear to have been diminished. Nevertheless, the discolouration is a negative factor, and the stone may be best suited for ashlar and veneer. If fresh material can be quarried, it would make an attractive thin veneer for interior use. Tiles cut from the quarry this year are very attractive, exhibiting a strongly foliated texture with scattered, 1 cm sized knots of pink feldspar and brown allanite, the whole having the appearance of petrified wood.

Future Work

The use of granite in the construction industry is still on the increase. Central Ontario possesses granites with a wide variety of colours and textures. In addition, there appears to be emerging some considerable investor interest in furthering the development of Ontario's stone industry. It is, therefore, important to identify additional quarriable sources of granite. It is planned to conduct detailed surveys in accessible parts of the Mulock Batholith, the Archean body in both Milne and adjacent townships, and in orthogneiss bodies in Parry Sound District. Further work to identify sources of thin-splitting gneissic flagstone will be undertaken in Parry Sound and Nipissing districts. Possible studies on other industrial minerals, including silica and garnet, will be reviewed.

Distribution of Mercury and Associated Elements in Lake Sediments in the Huntsville Area

Work commenced in March on a program to investigate the possible geochemical controls on the distribution of mercury and associated elements in a series of lakes in the Huntsville area. Twenty-two deep lake sediment cores were collected from 8 lakes in the Huntsville area in order to obtain complete geochemical profiles for Hg, LOI (loss on ignition) and a suite of 35 other elements. These lakes were selected because of the high mercury values in the sport fish in some of the lakes (OMOE and OMNR 1990). The results of this work have been presented in detail by Rasmussen (1991).

Gold and Base Metal Potential of the Central Gneiss Belt

A research project conducted over the winter of 1990–91 reviewed some of the literature on gold and base metal deposits in high-grade metamorphic terranes. This work was undertaken with an initial premise being that parts of the Britt, Kiosk, Algonquin, Rosseau and Go Home domains contain lithological assemblages which may be similar to those which host the Broken Hill type of base metal deposit, or stratabound gold deposits similar to those in the Kisseynew gneisses of Manitoba. Furthermore, recent geochronological studies suggest that the geological domains, listed above, may contain supracrustal rocks within the age range of 1.7 to 1.9 Ga, which is a significant metallogenic epoch in other parts of the world. Work on this project will be continued in 1992 by staff of the Dorset office.

RECOMMENDATIONS FOR EXPLORATION

The demand for new varieties of dimensional granite is still high. It is likely that many sites of quarriable stone remain to be recognized. Prospectors should focus most of their attention on metaplutonic bodies in the Britt, Rosseau and Kiosk domains. The key elements to look for are good topography to facilitate quarrying, attractive or unusual colours and textures, and as few joints and fractures as possible. There is also a good demand for thin-splitting granite flagstone for use as pavers, interior and exterior veneer, steps and landscaping stone. Such flagstone most commonly occurs in ductile shear zones between geological domains.

As mapping continues in the Parry Sound Domain, targets for gold exploration may become clearer, occurring perhaps within the gabbroic gneisses.

Pelitic and semipelitic gneisses host varying amounts and qualities of graphite. Graphitic metapelitic gneiss occurs within the Britt, Algonquin, Rosseau and Go Home domains, and is common within the ductile shear zones which bound the domains.

The Algonquin Resident Geologist's District contains such industrial rock and mineral commodities as marble, quartz, mica, graphite, anorthosite, garnet and wollastonite. These occurrences should be reviewed in the light of changing economic conditions and developments in mineral markets and applications.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

A. Bajc of the Engineering and Terrain Geology Section completed the second year of a 2 year program to map the glacial deposits and features of the district municipality of Muskoka. One of the primary objectives of this project was to identify landscapes with significant heritage values and to protect these sites through the municipal-planning process.

R. Kelly, Ontario Ministry of Northern Development and Mines, London, conducted a study of the Paleozoic geology in the Lake Simcoe area. He has evaluated the economic potential of these rocks for use as building stone, cement, high-purity calcium carbonate and high-specification aggregate.

RESEARCH BY OTHER AGENCIES

R. Macfie is continuing work toward his doctorate thesis at Queen's University, Kingston. He is studying structural problems at the junction of the Seguin, Moon River and Parry Sound domains.

S.B. Lumbers of the Royal Ontario Museum, Toronto, is mapping in the Gibson Lake area, north of Port Severn.

W. Klemens of the University of Toronto, Toronto, is conducting structural and metamorphic studies in the Ahmic Domain.

P. Rasmussen continued work on her PhD at the University of Waterloo, Waterloo. She is attempting to determine a) if the source of mercury occurring in some of the sport fish in several of the lakes in the Huntsville area is related to a geological source and b) to evaluate the relative importance of geological and atmospheric sources of Hg.

N.G. Culshaw of Dalhousie University, Nova Scotia, is continuing geological mapping and associated projects in the Georgian Bay area of the Central Gneiss Belt. The results of his mapping performed under funding provided by the Canada–Ontario Mineral Development Agreement (COMDA) are expected to be published as open file maps and, subsequently, as coloured maps by the Geological Survey of Canada in 1992.

D. Corrigan, Dalhousie University, Nova Scotia, has completed his PhD studies on structural and metamorphic problems in the Key Harbour area. J. Ketchum and N. Wodicka are continuing their PhD studies at Dalhousie University on structural, metamorphic and geochronological problems in the Shawanaga and Parry Sound areas, respectively.

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19. Southeastern Resident Geologist's District—1991

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INTRODUCTION

During 1991, 27 mines and 15 mills and plants operated in the Southeastern Resident Geologist's District. Products varied from building stone to gemstones to industrial minerals and magnesium. In addition, numerous pits and quarries which are producing construction aggregate are regulated by the Ontario Ministry of Natural Resources under the Aggregate Resources Act.

MINING ACTIVITY

Mining activity for the Southeastern Resident Geologist's District for 1991 is summarized in both Figure 19.1 and Table 19.1.

Most of the mines in the district operated at, or a little below, 1990 levels of production. There are, however, 4 mines at which significant change took place during the year. Two are new mines, and 2 are expanded operations. These 4 are described in the following paragraphs.

Upper Canada Stone Company Ltd.

Upper Canada Stone Company Ltd. owns a new quarry which opened in 1991 in the north half of Lot 15, Concession II, Mayo Township, south of McArthur Mills. The company crushed 16000 t of white, siliceous, dolomitic marble.

A narrow band of dolomitic marble is bordered on either side by biotite-quartz-plagioclase paragneiss and schist. The dolomite band varies in width from 100 to 200 m and has been traced for a strike length of over 700 m. The fine-grained marble is white to buff in colour and has a sugary texture. Impurities vary from 1 to 30% and are composed of quartz, tremolite and phlogopite (LeBaron and MacKinnon 1990).

The company plans to increase their production to 50 000 t per year in 1992. The stone is crushed to various sizes and is used in the decorative-landscaping industry.

I.K.O. Industries Ltd.

I.K.O. Industries Ltd. began developing a new quarry in 1991 to produce granules for their roofing-materials plant in Brampton. The quarry is located in Lot 3, Concession II, Madoc Township, approximately 5 km west of Madoc and 600 m south of Highway 7.

The first blast in their quarry took place in November, 1991, to establish a quarry face on the south side of an easterly trending ridge of grey to black, fine-grained, agglomeratic intermediate volcanic rock. Tests done by I.K.O. Industries Ltd. over the past 4 years have shown that this rock produces granules which can be coloured and are durable and which show no undesirable weathering effects, such as rust stains.

The company currently purchases pre-dyed granules from 3M Canada Inc. However, if the rock from the new quarry continues to meet the company's specifications, I.K.O. Industries Ltd. will quarry up to 1 million t per year, grind the material to granule size at the quarry site, and may eventually establish a dye plant in the Madoc area (L. Warner, I.K.O. Industries Ltd., Brampton, personal communication, 1991).

Beaver Construction Co. and H.J. McFarland Construction Co.

Beaver Construction Co. of Kingston, Ontario, was contracted to extract dimension stone from the Crookston limestone quarry owned by H.J. McFarland Construction Co. The contract calls for the production of 900 limestone blocks 1 by 1 by 1 m in size to be shipped to Montreal for construction of retaining walls for a man- made lake.

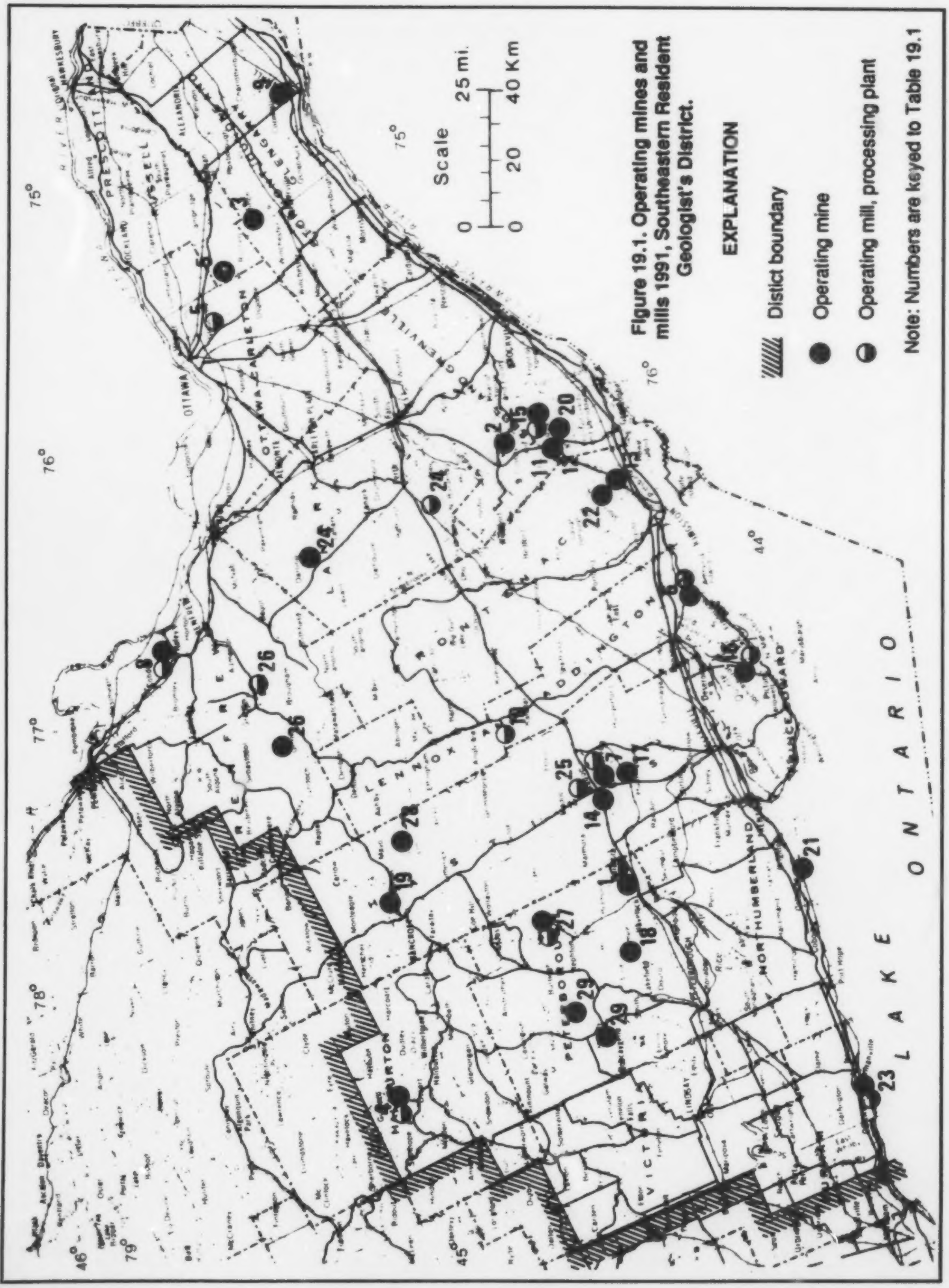
Scale
0 25 mi.
0 20 40 Km
EXPLANATION
Distict boundary
Operating mine
Operating mill, processing plant
Note: Numbers are keyed to Table 19.1
LAKE ONTARIO
OTTAWA
PRESCOTT
RUSSELL
GLENGARRY
STORMONT
DUNDAS
GRENVILLE
LEEDS
FRONTENAC
LENNOX
ADDINGTON
HASTINGS
PRINCE EDWARD
NORTHUMBERLAND
PETERBOROUGH
VICTORIA
HALIBURTON
RENFREW
LANARK
OTTAWA-CARLETON
46°
45°
44°
79°
78°
77°
76°
75°

Figure 19.1. Operating mines and mills 1991, Southeastern Resident Geologist's District.

TABLE 19.1. Mining Activity 1991, Southeastern Resident Geologists's District.

Map No.	Company	Mine or Quarry	Location (Township)	Commodities	Notes
1	3 M Canada Inc.		Belmont	Trap rock	Roofing granules are produced from trap rock at this mine and processing plant.
2	Arriscraft		Bastard	Sandstone	Sandstone for manufacture of reconstituted sandstone. Raw material is shipped to Cambridge, Ontario for processing.
3	Blair, A.L. Contruction Ltd.		Finch	Lime	Agricultural lime is produced from this quarry.
4	Bolenders Ltd.		Guilford	Dolomite	Dolomite (marble): poultry grit, golf sand decorative aggregate, and white powder for use in bricks and mortar are produced on site.
5	Canada Brick Division, Jannock Ltd.		Russell, Gloucester	Clay Products	Brick, from red shale. Quarry in Russell Tp, plant in Gloucester Tp.
	6 Canada Cement LaFarge Ltd.(Bath)		Ernestown	Cement	Limestone is quarried and cement is produced on site.
7	Canada Talc Ltd.	Henderson & Conley Mines	Huntingdon	Talc, Dolomite	Talc products, ground and crushed dolomite products including terrazzo chips are produced from this mine. Canada Talc operate 2 mills, one at the mine site and another at Marmora.
8	Chromasco Ltd.(Div. of Timminco)		Ross	Magnesium	Magnesium is produced on site from dolomite mined at this location. Strontium and calcium are produced from purchased material.
9	Cornwall Sand and Gravel		Cornwall	Limestone	Limestone blocks for dimension stone are produced on demand from thick upper beds from this quarry.
10	Easton Minerals Northbrook Ltd. Mill		Kaladar	Industrial Minerals	This mill processes talc and dolomite from Madoc Tp., granite from the Rear of Leeds and Lansdowne tps. and silica.
11	Easton Minerals Ltd		Rear of Leeds and Lansdowne	Granite	Decorative red granite aggregate is produced from this quarry.
12	Granimar Quarries Ltd	Straw Hill Quarry	Rear of Leeds and Lansdowne	Granite	Red granite blocks are mined, and shipped to dimension-stone plants.
13	Hughes, W.		Pittsburgh	Silica	Sandstone is mined for silica and sold for use in manufacture of portland cement.
14	I.K.O. Industries Ltd.		Madoc	Andesite	A quarry was opened in volcanic rock for the production of roofing granules.
15	Kingston Stone Products Ltd.		Rear of Leeds & Lansdowne	Sandstone Limestone	Sandstone is quarried from this site. A finishing plant for sandstone and limestone is also located here.
16	Lake Ontario Cement Ltd.		Sophiasburg	Cement	Limestone is quarried and cement is produced on site.
17	McFarland Construction Co.	Crookston	Huntingdon Quarry	Limestone	Large building stone blocks are produced on demand.
18	Payne, Eldred W.		Dummer	Limestone	Flagstone
19	Rasmussen, P.	Princess Sodalite Mine	Dungannon	Gemstones	Sodalite is mined and sold for mineral specimens.
20	Rideauview Contractors Ltd.		Rear of Leeds and Lansdowne	Sandstone	Sandstone building blocks (ashlar), and flagstone
21	Saint Lawrence Cement Co. Ltd.		Cramahe	Cement	Mine only. Rock is barged to Clarkson plant near Oakville for processing.

TABLE 19.1. Continued.

Map No.	Company	Mine or Quarry	Location (Township)	Commodities	Notes
22	Sloan, N.	Sloan Quarry	Storrington	Sandstone	Sandstone building blocks (ashlar).
23	St. Mary's Cement Ltd. (Bowmanville)		Darlington	Cement	Limestone is quarried and cement is produced on site.
24	Steep Rock Resources Inc.	Tatlock Quarry	Darling	Calcite	High-purity, finely ground calcite for fillers plus other grades of calcite, and marble chips. Mill is west of Perth.
25	Stoklosar Marble Quarries Ltd.		Madoc	Marble	Marble chips (terrazzo) are produced at this mill.
26	Two Island Marble Corp		Griffith	Marble	White marble dimension stone, finishing plant is at Dacre.
27	UNIMIN	Blue Mountain quarry	Methuen	Nepheline Syenite	Nepheline syenite produced from a mine in this township is processed in 2 mills. Magnetite is also produced.
28	Upper Canada Stone Ltd.	Quarry	Mayo	Marble	This quarry is in the initial stages of production
29	Windover, N.		Harvey	Limestone	Flagstone

The stone being quarried is a massive, 1 m thick bed of microcrystalline limestone of the Bobcaygeon Formation. A tractor-mounted, carbide-toothed circular-saw blade 3 m in diameter is used to make long parallel cuts 1 m apart. A rock drill and hydraulic splitter are then used to split 1 m blocks from the cut section.

Large blocks of this stone were extracted from the Crookston Quarry in the early 1900s and used in the construction of bridges in Montreal (Goudge 1938).

Two Island Marble Inc.

Two Island Marble Inc. continued producing a variety of products in 1991 ranging from cut and polished slabs to ashlar blocks. Their quarry, in Griffith Township, has expanded slightly over the previous year. The company added a guillotine for producing ashlar blocks to their finishing plant which is located in Dacre, Ontario. This plant was closed in the fall of 1991 for a couple of weeks due to decreased demand for its products.

Samples of the polished marble were displayed at the 29th Annual Verona Marble and Machine Fair in Italy, in September, 1991, and they attracted a lot of attention.

EXPLORATION ACTIVITY

Exploration activity is shown in Figure 19.2 and is listed in Table 19.2.

Exploration-activity indicators, listed in Table 19.2, show a marked decline in exploration for 1991 as compared to other years. Total man-days of assessment work recorded in the Southern Ontario Mining Division was down to 6730 (to November 1, 1991) compared to 30 804 in 1990. This reflects the general trend seen throughout the country. There were very few diamond-drilling projects undertaken in the Resident Geologist's District, with only 422 man-days being reported to November, 1991, compared to 7584 in 1990, and 22 470 in 1989.

Most of the grass-roots exploration activity that did take place was funded under the Ontario Prospectors Assistance Program (OPAP) and the Ontario Mineral Incentives Program (OMIP). During 1991 in the Southeastern Resident Geologist's District, OPAP approved $267 900 to 27 individual prospectors, and OMIP approved $186 251 for 7 exploration programs.

ADVANCED EXPLORATION AND DEVELOPMENT ACTIVITY

Stewart Lake Resources Inc.

Stewart Lake Resources Incorporated has been waiting for Bedford Township to pass a municipal-zoning amendment which would allow and also regulate their proposed mining activity in the township. This bylaw was passed in the fall of 1991. As well, the township also passed the relevant Official Plan amendments that would allow them to commence mining. The company must still wait as there was at least 1 registered objection to the bylaw which may require an Ontario Municipal Board hearing to determine the outcome. It is probable that such a hearing cannot take place until late 1992 or early 1993. The company had expected to go into production in 1991 but will not meet that objective. The Kirkham graphite property, in Bedford Township, contains mineable reserves of more than one million tons averaging 8.61% graphitic C and may support a production rate of 9000 tons per year (*The Northern Miner*, September 9, 1991, p.3).

Stewart Lake Resources Incorporated are now carrying out the bulk of their exploration efforts in the nation of Bulgaria where they are examining the feasibility of mining iron-ore pigments.

Victoria Graphite Ltd.

Victoria Graphite Ltd.'s property is located in Lot 10, Concession I, in Bastard Township, Leeds County, approximately 5.5 km northeast of the town of Portland. The graphite occurs in 3 zones within siliceous marble. It is estimated that 300 000 tons of 6% graphite occur within a proposed open pit to a depth of 20 m. A 150 t per day mill has been erected and includes an autogenous mill, a ball mill and floatation cells.

Production could begin as early as February, 1992, but is dependent upon financing for start-up costs. The company has spent $2 million to date on this project.

Ram Petroleums Ltd.

Ram Petroleums Ltd. have been evaluating a wollastonite occurrence located in Lot 4, Concession III, Olden Township, Frontenac County, approximately 6 km south-southeast of Mountain Grove. This occurrence is also known as the Hawley zinc property. Nineteen diamond-drill holes have been completed, and a feasibility study is currently being conducted.

The deposit is approximately 55 m wide, 75 m deep and has a strike length of 200 m. Reserves are estimated at 2.5 million t with the ore averaging 32% wollastonite. The wollastonite is white to beige in colour, is fine- to coarse-grained, and is approximately 1 to 3 mm in length. The crystals vary from bladed to short prismatic.

This product will be sold to the high-quality plastic-reinforcement market. Initial production is expected to commence in 1993 from an open-pit mine (*Industrial Minerals*, June, 1991, p.11).

Summit Lake Iron Deposit

The Summit Lake iron deposit is located in the south half of Lot 14, Concession III of South Canonto Township approximately 4.5 km north of the village of Ompah. The property consists of 3 zones–A through C.

The A zone is approximately 300 m long and up to 30 m wide and contains an estimated 3 million tons of magnetite averaging about 40% Fe. This zone is developed by an open cut measuring approximately 60 m long by 12 m wide by 8 m deep. Several thousand tons of magnetite ore were produced for Ontario Hydro for use in high-density containment shields employed in their nuclear reactors. Approximately 3000 tons of crushed ore and 2000 tons of broken ore remain at the site.

Zone B is located 100 m north of zone A and was identified by a gravity survey completed in 1964. This gravity anomaly is broader and more intense than that of zone A.

Zone C is about 600 m east-northeast of zone A and has been exposed by stripping. This high-grade magnetite zone is located within massive to banded amphibolite containing local narrow lenses and disseminations of magnetite.

The present owner of this property is attempting to develop markets in the USA for nuclear shielding, as well as other markets for boat ballast, heavy-media separation and black pigments used in paints, fillers, and concrete.

PROPERTY EXAMINATIONS

Calcite Prospect, Elzevir Township

The "Tweed calcium deposit" is located in the extreme south-central area of Elzevir Township about a mile southeast of the junction of highways 37 and 7. The deposit is 7000 feet in length by 350 to 800 feet wide. Part of the deposit is covered with thick overburden. The white calcite is in the range of 96.8% $CaCO_3$ and tests at 95.4% brightness with very low insolubles. The property is approximately 350 acres in extent and has been extensively drilled. Through various subsidiaries, Pluess-Staufer Ltd. has been leasing the property from C.R. Young since 1974 and just terminated the lease on November 1, 1991.

Building Stone Prospect, Belmont Township

The Belmont granite quarry is a past producer of dimension stone; it is located in Lot 31, Concession X, Belmont Township, about 15 km north of Havelock. The quarry was developed and operated for a short time during the 1960s by Vermont Marble Company. Fairmont Granite Limited renewed operations in 1982 but abandoned the quarry in 1983 due to limitations on quarry-block size caused by horizontal sheeting.

The quarry is situated at the top of a 25 m high, bare-outcrop ridge. The stone is a massive, pink, medium-grained biotite granite of uniform colour and texture. Vertical joint sets are very widely spaced (1.5 to 4 m), but a horizontal-joint set spaced at 0.3 to 1.0 m limits the quarry-block size in most cases. Some large blocks in the order of 1.5 by 1.5 by 2 m are present, but these represent a small percentage of the stone quarried.

The current owner of the quarry is re-mapping the joint sets and evaluating the building-stone potential as part of an OPAP grant. This owner hopes to reopen the quarry in 1992 to produce monument stone, ashlar, paving stone and curb

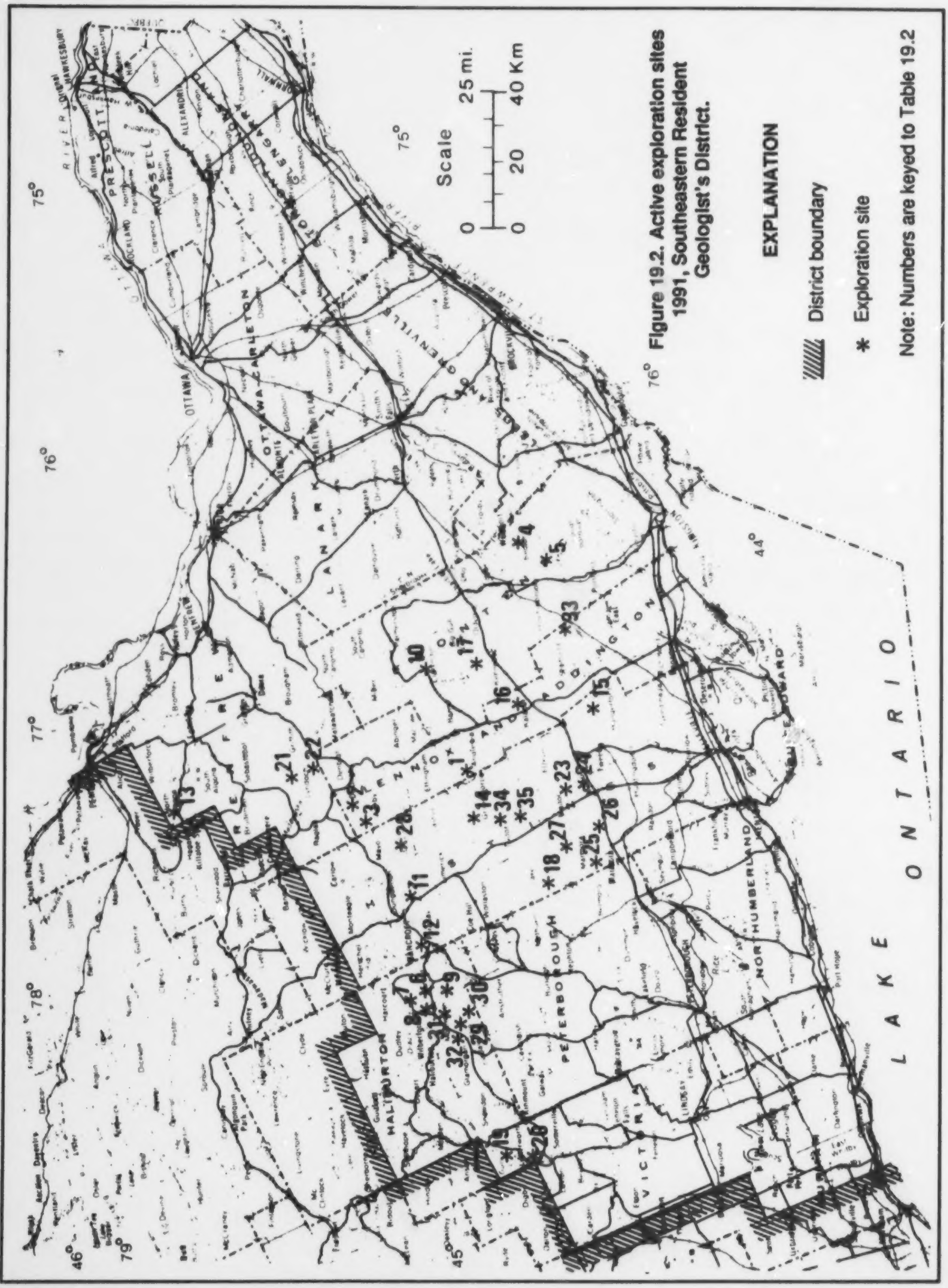

Figure 19.2. Active exploration sites 1991, Southeastern Resident Geologist's District.

Scale
0 25 mi.
0 20 40 Km
EXPLANATION
District boundary
* Exploration site
Note: Numbers are keyed to Table 19.2
LAKE ONTARIO
OTTAWA
PRESCOTT
RUSSELL
OTTAWA-CARLETON
GRENVILLE
LANARK
RENFREW
FRONTENAC
LENNOX AND ADDINGTON
HASTINGS
PRINCE EDWARD
NORTHUMBERLAND
PETERBOROUGH
HALIBURTON
VICTORIA
79°
78°
77°
76°
75°
46°
45°
44°
1
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TABLE 19.2. Exploration activity, 1991, Southeastern Resident Geologist's District.

Location (Township)	Company	Property Name	Commodities Sought	Comments
1. Anglesea	Dowhaluk, H.	Killer Creek Project	Gold	Geochemistry, geology, VLF-EM & magnetometer surveys
2. Ashby	Stewart, Ralph V.	Ruby Lake Property	Garnet, Sillimanite	Analysis & sample processing
3. Ashby	Stewart, Ralph V. Property	Parkhurst Lake	Garnet, Sillimanite	Analysis & sample processing
4. Bedford	Clinton Kehoe	Bedford Graphite Property	Graphite	Trenching & stripping
5. Bedford	Henry Douglas	Douglas Property	Base metals	Magnetometer & EM surveys & diamond drilling 3 drill holes
6. Cardiff	Opawica Explorations Inc.	Waterslide Showing	Rare earths	Surface sampling
7. Cardiff	Enertex Resources Ltd.	Halo Prospect	Uranium	Resampling & assaying of diamond-drill core
8. Cardiff	Uranex Resources Ltd.	North Zone Fluorite Prospect	Yttrium, rare earths, uranium & thorium	Surface sampling & assaying
9. Cardiff	Norlode Resources Inc.	Rare Earth Prospect	Yttrium, rare earths	Surface sampling & assaying
10. Clarendon	Steve J. Hill	Boerth-Hill Property	Gold, silver, zinc, base metals	Diamond drilling, 5 drill holes
11. Dungannon	Peter James Lacey			Stripping & trenching
12. Faraday	Offset Natural Resources Ltd.	Faraday Twp. Uranium Prospect	Yttrium, rare earths, uranium, thorium	Surface sampling & assaying
13. Fraser-N. Algona	James Lee			EM, scintillometer, & geological surveys
14. Grimsthorpe	Homestake Mineral Dev. Co.	Gilmour Property	Gold	Power stripping, sampling & trenching
15. Hungerford	Steep Rock Resources Inc.	Hungerford Mica Property	Muscovite	Diamond drilling of 1 hole
16. Kaladar	Steep Rock Resources Inc.		Muscovite	Diamond drilling of 1 hole
17. Kennebec	Samuel J. Alexander			Manual labour & mechanical work
18. Lake	Michael Osiel		Gold	Surface sampling, assaying & trenching
19. Lutterworth	Alar Soever	Buller Lake Property	Zinc	Geological & geochemical surveys
20. Lutterworth	Blaine R. Webster			Geophysical & geological surveys
21. Lyndoch	Canhorn Mining Corporation	Stoughton Lake Property		Petrographic study
22. Lyndoch	Edwin L. Speelman			Geochemical survey
23. Madoc	J.S. Thompson/R. W. Shewman	J.S. Thompson Property (Grenville project)	Gold	Till sampling & assaying
24. Madoc	Trisar Resources Ltd.	Madoc Talc Prospect	Talc	VLF-EM & magnetometer surveys
25. Marmora	John Ridgeway		Gold	Magnetometer survey, stripping, sampling & assaying
26. Marmora	Noranda Exploration Co. Ltd.	Deloro North Group Property	Gold	Stripping, sampling, & assaying, magnetometer & VLF-EM surveys, soil survey

TABLE 19.2. Continued.

Location (Township)	Company	Property Name	Commodities Sought	Comments
27. Marmora	Michael Osiel	Cordova Property	Gold	Geochemical survey, assaying
28. Mayo	Mangrove Bay Resources Inc.	Mayo Dolomite Prospect	Dolomite	Geological mapping, diamond drilling of 11 drill holes; trenching, sampling & assaying
29. Monmouth	Concentrated Rare Earth Minerals Ltd.	Blue Rock Prospect	Yttrium, rare earths,	Surface sampling, assaying uranium, thorium
30. Monmouth	Preston Resources Ltd.	Rare Earth Prospect	Yttrium, rare earths,	Surface sampling, assaying uranium, thorium
31. Monmouth	Saranac Resources Ltd.	Rare Earth Prospect	Yttrium, rare earths,	Surface sampling, assaying uranium, thorium
32. Monmouth	Scott Edward Harper			Trenching
33. Sheffield	Chris Wagg	Slave Lake Zinc	Zinc	Assays, geochemical, geological, VLF-EM & magnetometer surveys
34. Tudor-Grimsthorpe	Campbell James Laidlaw		Gold	Sampling, assaying, & stripping
35. Tudor	R.J. Dillman	Dillman-Tudor	Gold	Diamond drilling of 1 drill hole

Notes: Abbreviations used include VLF-EM (very low frequency electromagnetic), EM (electromagnetic) as pertains to geophysical surveys.

stone using the horizontal sheeting present at the site to their advantage as a natural splitting plane.

In November, 1991, The Campbell Monument Company Ltd. of Belleville purchased 4 good blocks at $15 per cubic foot for cutting into monuments, and 1 grout block for testing the suitability of the stone as a sculpting medium. It is hoped that this attractive stone will find a place in the monument industry.

Gold Occurrence, Tudor Township

A gold occurrence in Lot 20, Concession II, Tudor Township, discovered by local prospector N. Helm, was examined in 1991. The prospect is located about 100 m west of the old St. Charles iron mine—a skarn magnetite deposit at the contact between a marble and a diorite located close to the northern margin of the Tudor gabbro. A 3 m wide quartz vein striking northeasterly within the diorite and/or mafic metavolcanics has been exposed in trenches over a strike length of about 50 m. The vein contains minor pyrite and hematite. A composite sample of vuggy, hematitic quartz-vein material returned an assay of 0.8 g/t Au. Although most of the assays reported by N. Helm are less than 1 g/t Au, 1 sample contained a fine grain of native gold, identified by staff at the Tweed Resident Geologist's office. Additional prospecting, possibly combined with soil geochemistry sampling, may locate strike extensions of this vein and determine whether or not any parallel veins are present. The surveys should be extended westward to cover the contact between the mafic metavolcanics and trondhjemite of the Glanmire intrusive complex.

Gold Prospect, Tudor Township

A gold prospect in Lot 5, Concession XIII, Tudor Township, known as the Dillman occurrence, was explored by Homestake Mineral Development Company during the period 1989–1990. The company has since terminated the option and the owner is continuing his work on the property.

The gold prospect is hosted by a northerly trending, mylonitic granite body, from 70 to 125 m in width, flanked by mafic metavolcanics and metasediments. Gold is associated with arsenopyrite-bearing quartz veins which cut across the mylonitic fabric. Arsenopyrite is also locally disseminated within the granite host rock, but only low gold values are associated with this type of mineralization on this property. Christie (1989) reported gold assays of 3 to 12 g/t Au from quartz-arsenopyrite veins in granite and 2 to 3 g/t Au from granite containing disseminated arsenopyrite but no quartz veins. Gold mineralization occurs locally over a strike length of 1500 m within the mylonitic granite and may be related to crosscutting, northeasterly trending shear zones.

Copper-Antimony-Silver Occurrence, Hungerford Township

A tetrahedrite occurrence on the eastern side of Hawkins Bay near the boundary between Lots 8 and 9, Concession XIV, Hungerford Township, was explored in 1991 by a local prospector with the assistance of an OPAP grant.

The occurrence consists of a northerly striking quartz-vein zone about 3 to 4 m wide in calcitic marble. The vein contains 5 to 10% tetrahedrite with minor amounts of chalcopyrite, pyrite, azurite, and malachite. The marble contains aggregates of coarse-grained blades of pale-green tremolite bordering the quartz veins. The only exposure of the occurrence is within an old pit 3 to 4 m in diameter, now filled in with rock from the pit dump. Assays of up to 3% Cu, 0.09 ounce Au per ton, and 11.1 ounces Ag per ton have been obtained by the owner from grab samples of heavily mineralized vein material. This occurrence resembles the dolomitic marble hosted copper-antimony-gold-silver occurrences in Lavant and Darling townships. Geochemical prospecting should be useful in locating this type of mineralization within the area of the Hungerford Township occurrence.

RESIDENT GEOLOGIST STAFF ACTIVITIES

Services

The following briefly summarizes our normal activities. The Resident Geologist and his staff in the Tweed office provide a consultative technical service to people engaged in both mineral exploration and mining development in southeastern Ontario. This service involves consultations conducted both in the office and in the field and use of the Resident Geologist's library, files, and computer systems.

We provide comprehensive data on all known past mining and exploration activities in the Southeastern Resident Geologist's District, and monitor ongoing exploration and development. We also maintain contact with other government ministries and agencies on concerns that might have an impact on exploration or mining.

The Resident Geologist's clientele also use the diamond-drill core libraries at Tweed and Bancroft, for examining archived drill core and for logging newly drilled core. Geological maps and reports, claim maps, and prospectors' licences are sold by the Resident Geologist's secretary.

Staffing

In December of 1991, P.W. Kingston was the Resident Geologist, V.C. Papertzian was acting Staff Geologist, P.S. LeBaron was acting Drill Core Library Geologist and C.M. Neal was the Secretary. S. van Haaften was seconded to Toronto for 6 months, starting September 1, 1991, for a position with client services in the Geoscience Data Centre. L.A. Morgan was employed this summer as the Drill Core Library Assistant under the Experience '91 program.

The provincial Geoscience Exploration Database project (GED) began in Tweed in August, 1990. J.M. Ridgway, Contractor, carried out the Mineral Deposit Inventory (MDI) portion of the project. Information concerning approximately 3300 mineral occurrences in the district was coded and entered on-line into a computer data base located at the Ontario Geological Survey (OGS) in Toronto. The Southeastern Resident Geologist's District's Mineral Deposit Inventory part of the GED project was completed July 31, 1991.

P.S. LeBaron (LeBaron 1991) completed OFR 5808 entitled *Exploration for Gold in Southeastern Ontario, 1980—1990*. He also worked on a field trip guide compilation for this area; this project is ongoing.

The Regional Specialist, H.D. Meyn, has an office at Bancroft and was assisted by K. Fell, Secretary, and 2 student summer assistants. The program of the Regional Specialist is separate from the Resident Geologist's program, and in 1991 the Regional Specialist carried out geological mapping in the Madoc area. Claim tags, prospectors' licences and publications can be purchased at the Bancroft office. A library is also available there for public use.

Activities

In addition to providing regular services, the Resident Geologist and his staff undertook other activities.

P.W. Kingston served on the Mines and Minerals Information Technology Committee, the Land Use Planning for Mineral Resources Committee, the Provincial Core Library Committee and the Geoscience Exploration Database (GED) Working Group. C. Papertzian also served on the Provincial Core Library Committee, and S. van Haaften participated in the GED Working Group.

The Resident Geologist and Staff Geologist visited selected mineral prospects and active mines. Field trips and mine visits were arranged for explorationists who were new to the district. Detailed-planning input was provided for a number of different townships with respect to their official plans.

V.C. Papertzian and P.W. Kingston assembled a stone catalogue that was sent to an international stone show in Verona, Italy. The booklet featured photographs of building stone from 16 properties and was entitled *Selected Undeveloped Building Stone Sites in Southeastern Ontario, Canada* (Papertzian and Kingston 1991).

H.D. Meyn, Regional Specialist, and his staff set up a booth at the Bancroft Gemboree selling geoscientific publications issued by the Ontario Ministry of Northern Development and Mines. The ministry sponsored J. Mandarino at this event to identify rocks and minerals for the rockhounds. J. Mandarino is currently acting Associate Director of the Curatorial Department at the Royal Ontario Museum in Toronto.

A prospector's course was held in Tweed during Mining Week—June 3, 1991, to June 7, 1991. Approximately 25 people attended the course which comprised 4 three-hour-long classroom sessions followed by a 1 day field trip. P. Sangster, Staff Geologist from the Timmins Resident Geologist's office, was the chief instructor.

S. van Haaften taught the first session, which dealt with the general geology and mineral deposits of southeastern Ontario, and R.M. Charnesky, Mining Recorder for the Southern Ontario Mining Division, taught a session dealing with claim staking, assessment work, and the new Mining Act.

D. Leaper, Claims Inspector, and P.S. LeBaron jointly led the field trip which was held, in part, at the old Ore Chimney Mine in Barrie Township. This property contains a "model" mining claim for teaching purposes and is also an excellent site to show geology, structure and economic geology. A. Banner, who owns the property, spoke about his efforts to develop the property and about prospecting in general. Three other properties were also visited on this field trip.

RESEARCH BY RESIDENT GEOLOGIST'S OFFICE STAFF

Stratigraphy and Sedimentation of the Metasedimentary Rocks of the Grenville Supergroup in Southeastern Ontario

H.D. Meyn, Regional Specialist, Bancroft, started a detailed-mapping (1:5000 scale) program in 1988 in the metasedimentary rocks of the Madoc—Havelock area in order to determine if it is possible to conduct stratigraphic and sedimentation studies in these metamorphosed and deformed rocks. This was undertaken so as to get a better understanding of the setting of the known mineralization and to provide possible leads to additional mineralization. Mapping continued in 1989 and 1990 (Meyn 1988, 1989, 1990).

In 1991 detailed mapping (1:5000 scale) was carried out in Madoc Township, in the vicinity of Rimington, and in Belmont Township, in the area northeast of Belmont Lake.

This summer's field work in Madoc Township consisted of fill-in mapping along strike between previously mapped areas. The rock types present are the same as were encountered in previous years. The predominant lithology was a thinly laminated, grey calcitic marble. In certain local small patches occurring adjacent to structural dislocations, this marble may be white and massive. In the marble, a small amount of interbedded thin beds of arenaceous wacke or intermediate to felsic tuff is common. Because of their more siliceous composition, these beds are more resistant to weathering and thus protrude upward from the outcrop. The Regional Specialist encountered 1 occurrence of thinly laminated, dolomitic marble interbedded with calcitic marble.

The field work in Belmont Township extended the mapping range from Belmont Lake to the northeast. Most of Belmont Lake is underlain by the siliciclastic metasediments of the Belmont Lake formation. These sediments form a series of fining upward cycles. The tops of the cycles are characterized by dolomitic algal laminates. Northeastward from the shore of the lake, the amount of calcitic marble in the section increases. The exposed lithologies are a mixture of calcitic marble, massive beige-weathering dolomite, minor conglomerate, minor sandstone, and mudstone.

Economic Geology and Geochemistry of Grenville Carbonate Rocks

This project, carried out by S. van Haaften, Staff Geologist, Tweed, seeks to assess existing marble lithogeochemical data as an exploration tool by processing existing data and acquiring new data. In 1990 the already-existing carbonate-rock geochemical and rock-description data were published on floppy disks, together with a data base of more than 600 marble-hosted mineral occurrences (van Haaften and Meyn 1990). X-Y map plots and contour diagrams from the data were presented in a display and a talk at the 1990 Ontario Geoscience Symposium.

In 1991, the carbonate rocks data were brought into a geographic information system (GIS) using QUIKMap™* software. Federal government 1:250 000 scale topographic map data of the National Topographic System were obtained from the Ontario Geological Survey in AutoCAD® format for the Kingston and Pembroke map-sheet areas. A QUIKMap™ display area was defined in which topgraphic maps 31 C (Kingston), 31 D (Lake Simcoe), 31 E (Huntsville) and 31 F (Pembroke) can be displayed. Using the optional QUIKMap™-to-AutoCAD® conversion utility, the topgraphic data for map sheets 31 C and 31 F were easily imported to QUIKMap™ and displayed. Map sheets 31 E and 31 F will be incorporated into the GIS when they are received, but, for now, the data for those areas displays well in the otherwise featureless western part of the current computer-display screen.

All data from van Haaften and Meyn were brought into dBaseIV™ files which were then slightly modified to suit QUIKMap™. The dBase data displayed very well in the GIS, and it proved possible to zoom in and out to different screen-display scales and to display data base information for data symbols by pointing with the cursor and pressing a key. The carbonate-rocks GIS was described in a talk and display at the Ontario Ministry of Northern Development and Mines Directors' meeting held at Tweed in July, 1990. A plot from a zoomed-in view displaying Bedford Township is shown in Figure 19.3.

Beneficiation of Sillimanite from Eastern Ontario

During 1991, P.W. Kingston, Resident Geologist, Tweed, carried out research on possible beneficiation of sillimanite from deposits in southeastern Ontario. Several large- and medium-size deposits of sillimanite in quartz-mica-garnet

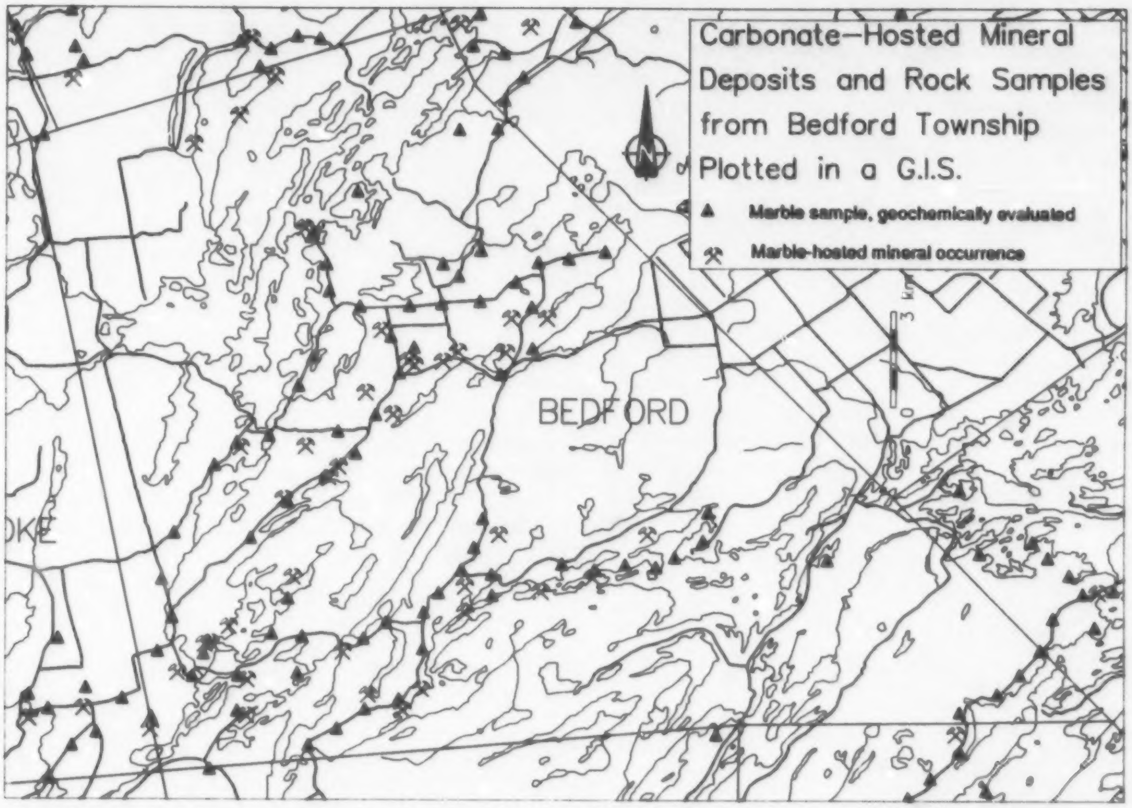
Carbonate–Hosted Mineral Deposits and Rock Samples from Bedford Township Plotted in a G.I.S.
▲ Marble sample, geochemically evaluated
⚒ Marble-hosted mineral occurrence
BEDFORD
OKE
3 km

Figure 19.3. Carbonate-hosted mineral deposits and rock samples from Bedford Township plotted in a Geographic Information System.

gneisses are known in southeastern Ontario. These have not been successfully developed because of an apparent lack of markets and/or lack of knowledge of how to make a high-value sillimanite product.

I.M.D. Laboratories Ltd. have been contracted to attempt to beneficiate sillimanite from a deposit in Ashby Township. The aim is to produce a high-aspect-ratio sillimanite product that would have application both as a functional filler in plastics and as a reinforcing component in ceramic-matrix composites. High-aspect-ratio sillimanite used for such high-technology applications would command a premium price, enabling economic development of one or more deposits.

The Ashby deposit was chosen for sampling for this study because the sillimanite's crystalline habit is strongly acicular and coarse grained in outcrop, and because some previous work on a weathered sample by the claim holder had yielded a high-aspect-ratio product.

At the time of writing, I.M.D. Laboratories Ltd. had produced a 40 mesh floatation concentrate and a 200 mesh floation concentrate of the nonmagnetic fraction. Both samples show blocky to high-aspect-ratio sillimanite particles. Some of those in the 40 mesh product contain inclusions of what is probably magnetite. These inclusions have been liberated in the 200 mesh product.

This sample from the Ashby deposit has proven to be exceptionally difficult to crush in its unweathered state, and the very heavy grinding required to achieve liberation seems to preclude easy separation of abundant high-aspect-ratio particles.

Although the beneficiated fractions studied to date do not show a high percentage of particles with aspect ratios over 5:1, this initial work does show that an economic high-aspect-ratio sillimanite product may be achievable from another deposit more amenable to beneficiation.

New Industrial Mineral Applications: Replacement of Fluorspar by Nepheline Syenite in Ladle Metallurgy Slags

For several years, P.W. Kingston, Resident Geologist, Tweed, and W.F. Caley, Department of Mining and Metallurgical Engineering, Technical University of Nova Scotia (TUNS), have been carrying out a joint technical program which examines possible new applications of industrial minerals.

One project involves a series of plant trials at The Sydney Steel Corporation, (SYSCO), in Sydney, Nova Scotia, in which the application of an Ontario-produced nepheline syenite product is examined both as a slag fluidizer and as a partial to complete replacement for fluorspar which is currently an expensive and environmentally undesirable component of the secondary-steel-making slags used in ladle metallurgy.

During our previous tests in March, 1990, we carried out 2 successful preliminary ladle trials. Since that time, SYSCO has extensively reviewed their steel-making practice as a result of switching to an electric-arc furnace, and that review has led SYSCO to significantly change their ideas on secondary- and synthetic-steel-making slags. This extensive review of the steel-making practice by SYSCO had delayed our trials for a while but by November, 1991, SYSCO was in a position to carry out further tests using Ontario-produced nepheline syenite as a major slag addition. In anticipation of further test work, a 2000 pound sample of nepheline syenite was collected, shipped in July, 1990, dried and weighed at Technical University of Nova Scotia in Halifax.

In November, 1991, SYSCO had conducted a full-scale ladle trial of our nepheline syenite as a complete replacement of fluorspar in the secondary-steel-making slag. T. Tribe, a graduate student in metallurgy at TUNS, was of great assistance during the trial.

This trial was significant in that this was the first trial in which fluorspar was completely replaced by nepheline syenite. In previous trials, only up to half of the fluorspar was replaced, and since fluorspar is such a powerful flux—and despite the fact that the results looked very promising—it was difficult to exactly evaluate the effectiveness of only partial fluorspar replacement.

The current trial started with melting, in the electric-arc furnace (EAF), an initial charge of scrap followed by a second charge of scrap after the first charge was melted. Additions of coke, ferrochrome, and several additions of lime were made to adjust the chemistry of the melt. When the EAF charge was at the correct temperature and the chemistry appropriate, approximately 100 000 pounds of molten steel was tapped into a clean ladle. It must be noted that during the tapping of the EAF, a circuit breaker tripped causing a delay in the removal of the ladle car. This in turn allowed roughly 2000 tc 4000 pounds of EAF slag to be added to the ladle, which should not have happened. During the tapping from the EAF into the ladle, approximately a ton of the special flux mixture containing 220 pounds of nepheline syenite—which replaced an equal weight of fluorspar—was added, thus, facilitating rapid melting and mixing of the slag with the steel.

The ladle then travelled to the ladle-refining furnace (LRF) where, after being brought back up to the operating temperature by an electric arc, the steel was ready to undergo the ladle-refining process. In the LRF, the steel is stirred with argon gas injected through a porous plug in the bottom of the ladle, its temperature adjusted and then special alloying elements such as ferrochromium, ferrosilicon and ferromanganese are added. The secondary-steel-making slag assists in deoxidizing, desulphurizing and in controlling inclusions in the final product. It also acts as a blanket to retard the cooling rate of ladle contents. Analysis of the steel during and at the end of this ladle-refining stage allows for adjustments to the chemistry to be made through the additions of various materials. The unfortunate presence of the spilled EAF slag in the ladle, mixed with the secondary-steel-making slag, complicated the refining process and somewhat confused the interpretation of the efficacy of the nepheline syenite.

After alloy addition and stirring in the LRF, the ladle is placed in the vacuum degasser to reduce hydrogen levels in the molten steel. Foaming of the slag in the degasser can be a serious problem, but the nepheline-containing secondary slag being tested had a low-foaming index. The ladle was finally transferred to the 3 strand continuous caster where casting of the heat presented no difficulties. The final chemistry of the steel was well within acceptable limits, thus, demonstrating the successful replacement of fluorspar by nepheline syenite. Additional trials, hopefully without EAF slag spillover, will be necessary to confirm the satisfactory results of the present test.

New Industrial Mineral Applications: The Potential Application of Natural Minerals in Ceramic and Metal-Matrix Composites

This research is part of an ongoing joint project between P.W. Kingston, Resident Geologist, Tweed, Ontario Ministry of Northern Development and Mines, and both W.F. Caley and G.J. Kipouros of the Department of Mining and Metallurgical Engineering, Technical University of Nova Scotia. This project examines new and nontraditional applications of industrial minerals in a number of areas. The research described here was presented as a paper at the Industrial Minerals Division Session at the 93rd Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Annual General Meeting, in Vancouver, May, 1991.

Current practice in advanced materials processing has involved the dispersion of a second phase—commonly SiC, glass or other nonmetallic fibres, whiskers or particulates—to enhance the physical characteristics of the matrix. These matrices may be either ceramic or metallic but in either case it is important that the physical and chemical properties of each phase be mutually compatible.

The dispersed, finely divided second phase is often both expensive and foreign produced and may exhibit chemical instability at elevated temperatures. Thus, it would appear that certain naturally occurring industrial minerals with fibrous, acicular or whisker habits might offer an attractive and low-cost alternative. Suitable candidates, such as wollastonite and sillimanite, are available in Canada and may be milled to produce particles whose shapes are appropriate for this application.

TABLE 19.3. Summary of claims recorded and assessment work credited, Southern Ontario Mining Division.

Year	Claims Recorded (*)	Claims Cancelled (*)	Claims Active (*)	Diamond Drilling (Man Days)	Geophysical Surveys (Man Days)	Geological Surveys (Man Days)	Other Work (Man Days)	Total Man Days
1980	548	721	1699	17648	6665	2822	3584	30719
1981	485	758	1531	11855	4041	4022	4699	24617
1982	354	617	1115	9546	8372	481	8927	27326
1983	391	377	1157	8317	2840	3135	5032	19324
1984	555	498	1254	9928	23500	322	3786	37536
1985	457	360	1312	15619	3192	650	5937	25398
1986	744	426	1579	15829	3623	3843	9304	32599
1987	619	526	1641	6672	24592	5721	5352	42337
1988	982	404	2255	17643	24345	2284	10087	54359
1989	598	729	2423	22470	14140	4017	8081	48708
1990	400	571	2302	7584	9980	1712	11528	30804
1991[1]	151	292	1683	422	1800	1862	2646	6730

[1] Data provided for the year [illegible] inclusive up to November 1, 1991, only.

(*) Figures include both single- and block-staked claims.

It is suggested that wollastonite, in particular, may be a useful modifying agent in metal-matrix composites utilizing Al, Al-Si, Zn-Al or other light metals and alloys. In addition, the possible use of these minerals in ceramic-matrix composites should also show promise.

Preliminary results from our ongoing research in the laboratory on use of high-aspect-ratio wollastonite in an aluminum-silicon alloy appears to be successful; this work is continuing. The next phase of research will involve the use of high-aspect-ratio sillimanite needles in the aluminum-silicon alloy and in zinc-aluminum alloys.

Gold Exploration in Southeastern Ontario

An open file report documenting the results of gold-exploration activities in southeastern Ontario during the period 1980 to 1990 was completed by P. LeBaron and released in September (LeBaron 1991).

Much of the previous documentation is based upon work carried out prior to 1940. The high level of exploration activity in the 1980s has produced several new gold discoveries and a substantial amount of new information about previously known occurrences. A total of 23 occurrences are described in detail within the open file report. These are classified according to host-rock type, and the general characteristics of each group are described. The lithologic, metamorphic and structural conditions common to the majority of the occurrences are identified and several areas are suggested as potential gold-exploration targets.

Southeastern Resident Geologist's District Geological-Field-Trip Data Base

This project, carried out by P.S. LeBaron, involves the cataloguing of geological-field-trip stops from all existing field-trip guides in the Southeastern Resident Geologist's District and the entering of locations and descriptions of each stop into the Geological Exploration Database (GED). This will provide a single source of information on easily accessible sites which demonstrate various aspects of the geology of the region. Sites can then be selected either by route (e.g., all stops on Highway 62 between Madoc and Bancroft), by area (e.g., all stops in Tudor Township) or by commodity (e.g., all nepheline occurrences), and these selected sites can then be plotted either on topographic maps using UTM co-ordinates or on computer-generated maps of the area selected using the QUIKmap, program. In addition to exploration and academ-

TABLE 19.4. Summary of Tweed Drill Core Library holdings to December 1, 1991.

Township	Company	Depth Drilled (m)	Core Stored (m)	Purpose or Commodity
Adolphustown	Ontario Hydro	63.4	42.0	Engineering
Alice	Site Investigation	20.8	18.6	Engineering
Ameliasburgh	Intera Keating	34.1	29.7	Engineering
Anglesea	Ultimate Energy Res.	398.6	256.7	Au
Athol	O.G.S. Hole	63.5	62.9	Engineering
Barrie	Grandad Resources	913.8	894.8	Au
	Henry Cook Property	76.2	76.2	Pb,Zn,Ag,Au
	Ore Chimney Mine	1369.5	1337.2	Au
	Quill Resources	1526.2	1466.0	Au
Bastard	Ontario Hydro	73.6	44.1	Engineering
Bathurst	Indusmin Ltd.	33.2	31.1	Silica
Bedford	Henry Douglas Property	67.6	59.7	Au
	Richardson Feldspar	339.0	327.6	Quartz
	Stewart Lake Resources	101.5	100.6	Graphite
Belmont	Blairton Iron Mine	1460.4	1202.4	Fe
	Cordova	2875.3	2489.6	Au
	Lasir Gold Inc.	9169.3	8891.1	Au
	Pershing Iron Mine	6712.3	5718.4	Fe
	Preussag	1211.9	1133.7	$CaCO_3$
Camden East	Roblindale Quarry	17.0	16.8	Scientific
Carden	K.J. Beamish Construction	39.5	0.8	Engineering
Charlottenville	Oliver Iron Mining	5290.4	1891.5	Fe
Clarendon	Selco Inc.	245.4	232.0	Zn
	St. Joe's Expl. Ltd.	905.0	905.0	Zn
Darling	Homestake Mineral Development Co.	1236.0	25.5	Au,Cu,Zn,Ag
Darlington	Ontario Hydro	18.8	7.3	Engineering
Durham	Ontario Hydro	128.9	91.7	Engineering
Edwardsburgh	Ontario Hydro	52.0	27.1	Engineering
Elizabethtown	Geocor Engineering Inc.	49.3	13.5	Engineering
	Min. of Transportation Ont.	28.0	17.8	Engineering
Elmsley	N. Globe Graphite Mine	698.2	634.0	Graphite
Elzevir	Corona Corp	702.6	652.0	Au
	Steeprock	516.2	492.0	Talc
Ernestown	Bethlehem Steel Corp	185.9	185.9	Fe
	Geocor Engineering	19.4	16.7	Engineering
	Ontario Hydro	67.4	22.0	Engineering
Front of Leeds & Landsdowne	Cominco Ltd.	699.5	645.9	Wollastonite
Gloucester	Min. of Transportation Ont.	31.7	31.2	Engineering
Goulborne	Ontario Hydro	254.4	69.6	Engineering
Grattan	Site Investigation Ltd.	111.2	108.1	Engineering
Harvey	Gormley Aggregates Ltd.	28.3	13.4	Engineering
Hope	Ontario Hydro	4453.6	1822.6	Engineering
Hungerford	Ram Petroleums Ltd.	157.9	157.9	Mica
	Strathcona Mineral Services Ltd.	75.0	74.2	Mica
Kaladar	Cathedral Gold Corp.	1131.9	1039.6	Au
	E&B Explorations Inc.	7817.7	7817.7	Au
Kaladar	J. Byer	123.1	121.2	Feldspar
	Lacana Mining Corp.	85.3	71.9	Mica
	Strathcona Mineral Services Ltd.	63.0	58.7	Mica
	C.R. Young	78.3	75.9	Mica
Kingston	Geocor Engineering Inc.	85.7	13.7	Engineering
	Ontario Hydro	70.4	17.0	Engineering
Kitley	Ontario Hydro	85.5	39.5	Engineering
Lanark	Selco Clyde River	1448.3	1267.4	Zn
Lavant	Homestake Mineral Development Co.	264.8	4.8	Au
Loughborough	Ontario Hydro	121.7	78.5	Engineering
Madoc	Bannockburn Mine	260.6	177.8	Au
	Derry, Michener, Booth	600.9	591.1	Talc
	Faith Mines Ltd.	5858.3	5479.8	Au
	Freeport Exploration	3192.6	2244.3	Base Metals
	Harwin Expl. & Devel.	792.5	792.5	Au

TABLE 19.4. Continued.

Township	Company	Depth Drilled (m)	Core Stored (m)	Purpose or Commodity
Madoc (continued)	Mono Gold Mines Inc.	17 964.2	17 852.6	Au
	Noranda Exploration Co. Ltd.	657.0	153.0	Au
	Sager	1562.3	1330.1	Base Metals
	SSFC/OGS	107.3	107.3	Scientific
	Syngenore	3438.4	2388.8	Base Metals
	Twin Buttes	150.3	150.3	Talc
Mara	Mardon Quarry Co.	74.5	21.2	Engineering
Marlborough	Ontario Hydro	3.9	2.0	Engineering
Marmora	Ackerman	37.1	37.0	Au
	Belmar Resources Inc.	374.1	361.0	Au
	Bethlehem Steel Corp.	8706.5	478.8	Fe
	Champion Gold Resources Inc.	484.0	465.8	Au
	Faith Mines Ltd.	789.7	760.7	Au
	Gold Brooke Expl.	795.0	810.9	Au
	Marmoraton Iron Mine	4080.5	3602.5	Fe
	Noranda Exploration Co. Ltd.	930.0	302.0	Au
Medonte	Ministry of Transportation	30.8	29.9	Engineering
Methuen	Preussag	190.6	175.7	$CaCO_3$
Montague	Ontario Hydro	45.4	28.0	Engineering
North Burgess	Indusmin Ltd.	115.9	98.1	Silica
	Lodi Metals Inc.	250.9	242.0	Graphite
	O.M.N.R.	52.4	51.6	Vermiculite
North Crosby	Indusmin Ltd.	129.3	102.8	Silica
	MTC Westport ddh	32.0	32.0	Engineering
North Fredricksburgh	Ontario Hydro	164.6	152.7	Engineering
Olden	Lynx Canada Expl.	15 825.8	14 711.5	Zn
OPS	OGS/SSFC	155.1	149.3	Scientific
Orillia	Sparrow Lake	18.0	16.9	Limestone
Osnabruck	Geocor Engineering Inc.	9.8	1.8	Engineering
Otonabee	Murray Little Property	96.3	90.8	Engineering
Palmerston	Fairfield Projects	152.4	146.8	U
Pickering	Ontario Hydro	326.4	216.7	Engineering
Portland	Ontario Hydro	8.5	6.5	Engineering
Prescott	Ontario Hydro	6.7	2.1	Engineering
Rama	Min. of Transportation Ont.	33.5	6.5	Engineering
	Longford Drillhole	33.8	7.0	Engineering
Ramsay	J.M. Bell	665.4	665.4	Base Metals
	Min. of Transportation Ont.	5.8	5.8	Engineering
Rideau	Ontario Hydro	23.8	17.3	Engineering
Seymour	Allan's Mills	3530.8	3170.1	Fe
Sommerville	Dudman Quarry Co.	56.5	19.6	Engineering
	Mason Property	31.7	5.2	Limestone
	OGS/SSFC	28.0	28.0	Scientific
Sophiasburgh	Ontario Hydro	83.5	52.1	Engineering
South	Crosby Indusmin Ltd.	391.5	342.3	Silica
	Ontario Hydro	95.7	35.9	Engineering
South	Elmsley Ontario Hydro	82.8	25.1	Engineering
South	Fredricksburg Lennox Generat. Stn.	107.5	107.5	Engineering
	Ontario Hydro	55.4	19.0	Engineering
Storrington	Indusmin Ltd.	75.5	62.4	Silica
	Ontario Hydro	91.0	61.9	Engineering
Thurlow	Site Investigation Ltd.	53.1	38.0	Engineering
Tudor	Helm, Nathan	255.5	251.5	Au
	Noranda Exploration Co. Ltd.	228.0	212.0	Au
	Wolfex Expl. Ltd.	75.8	75.8	Au,Ag
Tyendinaga	Ontario Hydro	207.4	159.7	Engineering
Wentworth PQ	Black Gregor Expl.	84.4	83.1	Graphite
Woodhouse	Oliver Iron Mining	1540.5	509.1	Fe
Total		130 205.0	104 309.5	

TABLE 19.5. Summary of Bancroft Drill Core Library holdings to December 1, 1991.

Township	Company	Depth Drilled (m)	Core Stored (m)	Commodity, Purpose
Anstruther	Biron Bay Resources Ltd.	2600.8	2600.8	Fe, Ti
	Esso Minerals Canada	1008.0	972.2	U, Th
	Glen Explorations	181.4	2.7	U, Th
	Northgate Exploration Ltd.	384.3	339.0	U, Mo
Blithfield	Ontario Hydro	174.2	127.5	Structure
Brougham	Coronation Resources	529.1	307.7	Graphite
	Ontario Hydro	204.9	98.8	Structure
Burleigh	L.V. Lomas Chem Co. Ltd.	243.8	3.6	Marble
Butt	Vesuvius Crucibles	1248.3	1163.0	Graphite
Cardiff	Esso Minerals Canada	3558.1	3019.1	U, Th
	Griffis, A.T.	294.4	3.8	Graphite
	Kenmac Chibougamau Mines	691.3	396.2	U, Th
	Kerr Addison Mines Ltd.	10 478.6	9691.3	U, Th
Cashel	David McMurray	290.1	285.6	Talc
Cavendish	Quebec Uranium Mines Ltd.	459.3	6.0	U
Dungannon	Jayfran Enterprises	681.2	639.6	Neph. syen.
Faraday	Madawaska Mines	3234.3	632.6	U, Th
	Mercier Exploration	735.3	10.7	U, Th
Finlayson	Canadian Gold Resources Inc.	274.6	267.0	Au
Galway	Halas, Frank	504.4	6.0	U
Glamorgan	Esso Minerals Canada	943.1	732.0	U, Th
	Sulpetro Minerals Ltd.	373.7	373.7	Zn
Laurier	Trout Creek	161.8	131.0	Graphite
Limerick	Lac Minerals Ltd.	13 281.6	9295.9	Cu,Ni,Co
Mayo	Falconbridge Ltd.	421.9	421.9	Fe
Methuen	Indusmin Ltd.	92.2	92.0	Neph. syen.
Monmouth	Esso Minerals Canada	5256.1	4321.5	U
Monteagle	Esso Minerals Canada	192.8	177.7	U
Forefront	Uranium Mines Ltd.	609.8	205.2	U
	Hobbs, L.G.	220.8	1.6	U
Murchison	Comet Quartz	336.0	283.0	Quartz
Ryerson	Graphite Corp. of Canada	1338.0	1299.5	Graphite
	Ryerson Graphite	1113.0	1044.8	Graphite
Snowdon	Sulpetro Minerals Ltd.	11 320.3	10 600.2	Zn
Total		63 437.5	49 553.2	

Note: Abbreviation "Neph. syen." refers to nepheline syenite.

ic uses, this data base is intended to be accessible to the general public. It is proposed that a number of field-trip stops be described for the layman as an introduction to the geological history of the area and to explain the uses of various rocks and minerals in everyday life.

The author worked on the initial stage of this project in 1991, compiling and plotting field-trip stops from existing guidebooks.

DIAMOND-DRILL CORE LIBRARIES

Tweed Drill Core Library

The Tweed Drill Core Library was managed by V.C. Papertzian until September 1, 1991. P.S. LeBaron then managed this facility for the balance of the year. L.A. Morgan acted as the assistant from June through August under the experience '91 program.

The following resources and services are offered at the Tweed Drill Core Library:

1. drill core from southern Ontario
2. facilities for logging and splitting core
3. binocular and petrographic microscopes
4. rock-cutting and polishing equipment
5. level and section plans from past-producing mines in the area

TABLE 19.6. Mines and Minerals Division Publications Relating to the Southeastern District which were released in 1991.

Note: the following abbreviations used here are defined.
ARIP..Aggregate Resources Inventory Paper
OFR...Open File Report
MAP...Final Map (normally in colour)

OPEN FILE REPORTS

Publication	Description
OFR 5751	Precambrian—Paleozoic Unconformity and Related Mineralization in Southeastern Ontario; by G. DiPrisco and J.S. Springer, 122p.
OFR 5740	Trace Element Behavior During Weathering of Till from Eastern Ontario, with Implications for Geochemical Exploration, Ontario Geoscience Research Grant no.336; by A.C.L. Larocque, 200p.
OFR 5770	Paleozoic Geology of the Ottawa—St. Lawrence Lowlands, Southern Ontario; by D.A. Williams, 292p.
OFR 5778	The Characterization of Bogs Using Ground-Penetrating RADAR, Ontario Geoscience Research Grant no.310 and no.354; by D.C. Nobes and B.G. Warner, 262p.
OFR 5801	Buried Sand and Gravel Features and Blending Sands in Eastern Ontario; by G.A. Gorrell, 256p.
OFR 5808	Exploration for Gold in Southeastern Ontario, 1980—1990; by P.S. LeBaron, 147p.

MAPS

Publication	Description
Map 2544	Bedrock Geology of Ontario, Southern Sheet; by staff of the Ontario Geological Survey, scale 1:1 000 000.
Map 2556	Quaternary Geology of Ontario, Southern Sheet; by P.J. Barnett, W.R. Cowan and A.P. Henry, scale 1:1 000 000.
Map 2587	Shaded Image of Total Magnetic Field of Ontario, Southern Sheet; by V.K. Gupta, scale 1:1 000 000.
Map 2591	Vertical Magnetic Gradient of Ontario, Southern Sheet; by V.K. Gupta, scale 1:1 000 000.

AGGREGATE RESOURCES INVENTORY PAPERS

Publication	Description
ARIP 148	Aggregate Resources Inventory of Burleigh and Anstruther township, Chandos Township and Methuen Geographic Township, Peterborough County; by staff of Engineering and Terrain Geology Section, 57p.

As of December 1, 1991, there were 102 294 m of drill core catalogued at the Tweed facility. Approximately 4000 m of recently acquired drill core has yet to be added to the inventory. Table 19.4 summarizes the library's holdings. During 1991, 7906 m of drill core were collected.

Major contributers of drill core this year were Lodi Minerals Ltd., which contributed drill core from 46 drill holes from their Timmins graphite property in North Burgess Township Municipality; Quill Resources Inc., which contributed material from 13 drill holes from their Barrie Township property; and Faith Mines Ltd., which contributed drill core obtained from 97 drill holes from the Sophia Diamond Mine property in Madoc Township.

There were 45 visitors to the facility between January 1, 1991, and December 1, 1991.

Bancroft Drill Core Library

The drill core library in Bancroft was staffed by V.C. Papertzian and P.S. LeBaron on an as-needed basis from the Tweed Resident Geologist's office.

Drill core from the northern part of the Southeastern Resident Geologist's District and also from the Algonquin Resident Geologist's District is stored at the Bancroft facility. As of December 1, 1991, 34 917 m of drill core were stored inside, whereas 19 724 m were stored outside on a nearby pad. Table 19.5 summarizes the drill core that is stored in the Bancroft Drill Core Library. There were no major contributors of core to the Bancroft facility this year.

RECOMMENDATIONS FOR EXPLORATION

Industrial minerals are the mainstay of the Southeastern Resident Geologist's District's mining activity. The district's proximity to markets and its diverse range of industrial mineral commodities make exploration for industrial minerals potentially worthwhile. White mineral fillers and dimension stone of uncommon colours, such as black and red granite, make attractive exploration targets.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

R.M. Easton, Geologist, Precambrian Geology Section, carried out detailed mapping in the Mazinaw Lake area in Lennox and Addington, and Frontenac geographic counties.

The mapping of aggregate deposits at a scale of 1:50 000 should be completed in Haldimand Township in Northumberland geographic county by the end of the fiscal year; this mapping is by the staff of the Engineering and Terrain Geology Section.

Publications released in 1991 that are applicable to the Southeastern Resident Geologist's District are listed in Table 19.6.

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van Haaften, S. and Meyn, H.D. 1990. Computer data relating to the economic geology and geochemistry of Grenville carbonate rocks in southeastern Ontario; Ontario Geological Survey, Open File Report 5960, 13 p., and two 5.25 inch double-density MS-DOS diskettes containing comma-delimited ASCII files.

20. Southwestern Resident Geologist's District—1991

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INTRODUCTION

The Southwestern Resident Geologist's District, geologically, is characterized by Quaternary glacial deposits and underlying Paleozoic bedrock. The Paleozoic bedrock comprises strata of carbonates, shales, sandstone, salt and gypsum.

The industrial mineral resources of the Southwestern District provide much of Ontario's structural material and nonmetallic mineral wealth. The district provides the entire provinces production of salt and gypsum and a large percentage of the shale, crushed stone aggregate, sand and gravel, calcined lime, cement and "limestone" and sandstone building stone.

During 1991 production from two new industrial mineral projects commenced. Domtar Incorporated began mining gypsum from their Number 3 Mine at Caledonia in the spring of the year. Brampton Brick began extraction of Queenston shale from their Cheltenham pit for test batching in late 1990, with full production from the site beginning in early 1991.

Mineral exploration in the district focuses primarily on construction aggregates and petroleum resources (*see* Carter, this volume).

Despite the slow economic times, requests for geological information pertaining to location of construction aggregate sources and building stone sources remained steady.

MINING ACTIVITIES

During 1991, a total of 40 mineral properties remained active in the Southwestern District. These operations produce salt, gypsum, clay and shale, building stone and limestone and dolostone products. The locations of all active operations are indicated on Figure 20.1.

Gypsum

Gypsum is extracted from the Salina Formation in underground mines at the following three locations: Drumbo, Hagersville and Caledonia. Room-and-pillar mining techniques are employed at two of the mines while the third, Caledonia, utilizes continuous mining, which eliminates the need for drilling and blasting.

Gypsum is used primarily to produce wallboard for the construction industry while lesser amounts are used for plaster products, soil conditioners, food additives, fillers and as a settling retardant in cement. Since the main use of gypsum is the production of wallboard, the past year's slow construction market severely affected production at all mines. Production in the range of 50% of capacity was reported by all operations.

The Canadian Gypsum Company operates a mine and wallboard plant north of Hagersville. Gypsum is extracted from a 1 m thick gypsum bed at a depth of 30 m. The company switched mining from what is known as the west mine to the east mine during the year. Mineral reserves in the west mine are virtually depleted.

Westroc Industries Limited mines a 1.7 m thick bed of gypsum at a depth of 116 m in their Drumbo mine, east of Woodstock. Crude gypsum is shipped to the company's wallboard plant in Mississauga for processing.

Domtar Incorporated (Construction Materials Group, Gypsum Division) began full production from their Number 3 Mine in 1991 and ceased mining at their Number 2 Mine. The Number 2 Mine had been slated to remain open for 2 to 3 years, however, with the current poor gypsum market it was decided to suspend operations early.

The new Number 3 Mine, located immediately east of the Number 2 Mine, utilizes continuous mining techniques to extract raw gypsum. Two Paurat tunneling machines are employed to cut gypsum from a 2.06 to 4.08 m thick seam of gypsum approximately 20 m below surface. Reserves are estimated to be in excess of 75 years.

Salt

Rock salt is extracted by underground mining methods at Goderich and Windsor. Mined horizons are located within the Salina Formation. Salt production is virtually recession proof, depending largely on weather conditions, thus output from both mines remained strong throughout the year.

Sifto Canada Incorporated's Goderich Mine utilizes a modified room-and-pillar mining design in extracting salt from the 23 m thick Salina A-2 unit, some 537 m below surface. Production levels at the mine in 1991 reached a record 3.6 million tons.

The Canadian Salt Company Limited employs conventional room-and-pillar mining techniques at their Ojibway Mine in Windsor. Salt is extracted from the 7.5 m thick

Middle F Unit of the Salina Formation some 297 m below surface. Following a prolonged strike at the mine in 1990 production rebounded in 1991 to a level of 2.5 million tons.

SALT-IN-BRINE

General Chemical Canada Limited, at Amherstburg, continued to extract salt by underground solution mining methods for on-site industrial use. Salina B salt beds, 30 and 21 m thick at an average depth of 335 m are utilized. One new solution mining well was completed during the year.

Dow Chemical Canada Inc. extracts salt by brining for industrial use from Salina B and A-2 Unit beds, 80 and 37 m thick respectively at average depths of 740 and 780 m in the Sarnia-Corunna area.

The extraction of salt by solution mining techniques by both companies is entirely for the industrial production of chloralkalis. Chlorine and caustic soda are produced by Dow Chemical while soda ash is produced by General Chemical.

FINE-GRANULAR VACUUM SALT

The Canadian Salt Company Limited and Sifto Canada Inc. continued to extract Salina B Unit salt brines from beds 30 and 55 m thick respectively at depths varying between 427 and 457 m in the Windsor and Goderich areas. Production figures for the two operations are Canadian Salt 150 000 tonnes and Sifto Canada 100 000 tonnes annually.

The brine is utilized for the manufacture of evaporated, purified, fine-granular salt products. Products include food-grade salt markets (60%), chemical industry (30 to 40%), and agricultural uses (10 to 20%).

Clay and Shale

The slow economy caused the existing clay and shale operations in the district to operate at approximately 50% of capacity. Projections for 1992 suggest a slight increase in demand for heavy clay products.

During 1991 Brampton Brick began full extraction of Queenston shale from their Cheltenham pit, located north of Brampton. Shale from this pit supplies Brampton Brick's brick plant at Snelgrove. The company extracted approximately 170 000 tonnes of shale, an amount just slightly over half of the allowed extractable maximum.

Canada Brick operates seven shale pits in the district which supply raw materials to seven company plants. The majority of the company's production is geared toward brick manufacture, however, the recently acquired Canada Vitrified Products plant at St. Thomas produces flue liner and sewer pipe. The company also supplies raw materials from their Aldershot (Burlington) pit to the Hamilton Brick Company. Production levels for the year were approximately 235 million bricks or less than 50% of capacity. Demand for flue liner and soft-mud brick products remained firm during the year. Production levels of soft-mud brick from the company's Wallenstein plant doubled to some 12 million bricks from the previous years output of 6 million. The company introduced a number of new brick styles and a new larger brick for commercial applications during 1991.

Martin Clay Products operates two shale pits in the district, one at Georgetown and the other near Arkona. Combined shale extraction from both pits totalled approximately 2 700 tonnes. The company uses these materials to produce brick and specialized thin brick which is utilized in the construction of prefabricated exterior wall panels. Future demand for this specialized product is expected to increase.

George Coultis and Sons Limited operate a small shale quarry near Thedford. Shale production from this pit totalled some 4 000 tonnes for the year. The company no longer manufactures heavy clay products at Thedford, instead raw materials are shipped to Paisley Brick and Tile Company Limited and Norwich Brick and Tile Company to be used in the manufacture of drainage tile.

Halton Ceramics at Burlington ceased operations during the year. It is reported that the company's property has been sold for development.

Building Stone

A variety of building stone types are produced within the district. Demand for building stone products remains strong with interest being shown in developing new sources.

Sandstone building stone is produced from the Whirlpool Formation at three operations situated between Georgetown and Inglewood. Two additional licensed properties, in the Inglewood area, owned by Credit Valley Quarries Company Limited are being valuated for possible reopening. The Whirlpool sandstone (Credit Valley) is found in grey, red and mottled red and grey colour varieties. The red and mottled varieties are currently available only at the Deforest Brothers Quarry at Inglewood. Grey sandstone is available at the quarries of Rice and McHarg, Limehouse and Hilltop Stone and Supply near Georgetown as well as the Deforest Brothers operation. Products from the Whirlpool sandstone include random and squared flagstone, copings, drywall, coursing and doubles. Larger slabs for steps or hearths are less commonly produced.

Adair Marble Quarries Division of Arriscraft Corporation quarries 10 tonne dimension stone blocks from bluish-grey mottled dolostone of the Wiarton-Colpoy Bay Member of the Amabel Formation near Hope Bay in the Bruce Peninsula. A buff coloured or "sepia stone" encountered in the quarry is also utilized for building stone products. The large mill blocks are transported to the company's finishing plant in Cambridge where a variety or architectural stone products are produced.

The Bruce Peninsula is also home to a number of building stone quarries which utilize the Eramosa Member of the Amabel Formation. The largest of these operations, Owen Sound Ledgerock, operates two quarries and a modern sawing and finishing facility. The company also finishes other domestic and imported stones.

The quarries working the Eramosa stone produce random and cut flagstone, coping, sills, drywall and slabs for hearths, mantels, counters and flooring.

RESIDENT GEOLOGIST'S STAFF ACTIVITIES

The office of the Resident Geologist is located at 659 Exeter Road, London, in the main provincial government building. Adjacent facilities include the Soils and Aggregates Testing facility of the Ministry of Transportation and the Petroleum Resources Laboratory of the Ministry of Natural Resources. The Petroleum Resources Laboratory includes facilities for the storage of drill core and cuttings.

The office of the Resident Geologist provides advisory services to industry, government agencies and the general public. Technical advice includes support for exploration and development, land-use planning, academic studies, and general interest inquiries. The office maintains a publicly accessible geoscience and mineral resource information library. The Southwestern District component of the Geoscience Exploration Database (GED) was completed in the spring of 1991 by R. Goad of London. This database is currently available for public use in paper file format only. Computerization of each Resident Geologist's office will allow the public easy access to mineral resource information for all parts of the province, and is scheduled for completion in the summer of 1992.

The office sells maps and reports published by the Mines and Minerals Division and provides services required to obtain prospector's licenses and claim tags. Forms for staking and claim working are also available.

During the year, consultative services provided to companies included: 1) evaluation of sandstone building stone resources; 2) sources of high specification crushed stone aggregate, high purity limestone and dolostone, silica fillers and very pure gypsum sources; 3) utilization of kaolin from northern Ontario in specialized cement manufacture; and 4) evaluation of glacial clay-marl for skin care products.

The Southwestern District office in London is staffed by B.H. Feenstra, Resident Geologist, R.I. Kelly, Geologist, and P. Smith, Program Secretary. During the year the office employed geological assistants M. Fraser, J. Baker, A.P. Henry and D. Daum (Experience '91 program). Other staff included D. Cardelli, under a Section 25 Employment Canada Program in conjunction with Federal White Cement (FWC) of Woodstock and L. Heaton on a temporary service contract with Kelly Services.

A number of projects initiated by the office last year continued and are nearing completion. These include: 1) overburden drilling to evaluate aggregate potential in McGillivray Township and subsurface stratigraphy in the Beaver Valley; 2) evaluation of southwestern Ontario Paleozoic carbonate resources for various industrial applications; and 3) a Quaternary geological investigation of the Woodbridge Area of Natural and Scientific Interest (ANSI) site. One longer term project (the assessment of mineral resource potential of the Lake Simcoe area) continued into its second year. The Ontario Geological Survey is currently conducting detailed Paleozoic bedrock mapping of the Lake Simcoe region.

New projects which have either been completed or are continuing included: 1) review and input into the Niagara Escarpment Commission 5 year plan review process, 2) construction of an outdoor education rock garden in conjunction with the University of Western Ontario, and 3) investigation of suitable sources of red Whirlpool Formation (Credit Valley) sandstone for possible restoration of the main legislative building at Queen's Park. The latter project involved locating, documenting and sampling suitable, currently licensed sources and one of the original sources of red, Credit Valley sandstone used to construct Queen's Park.

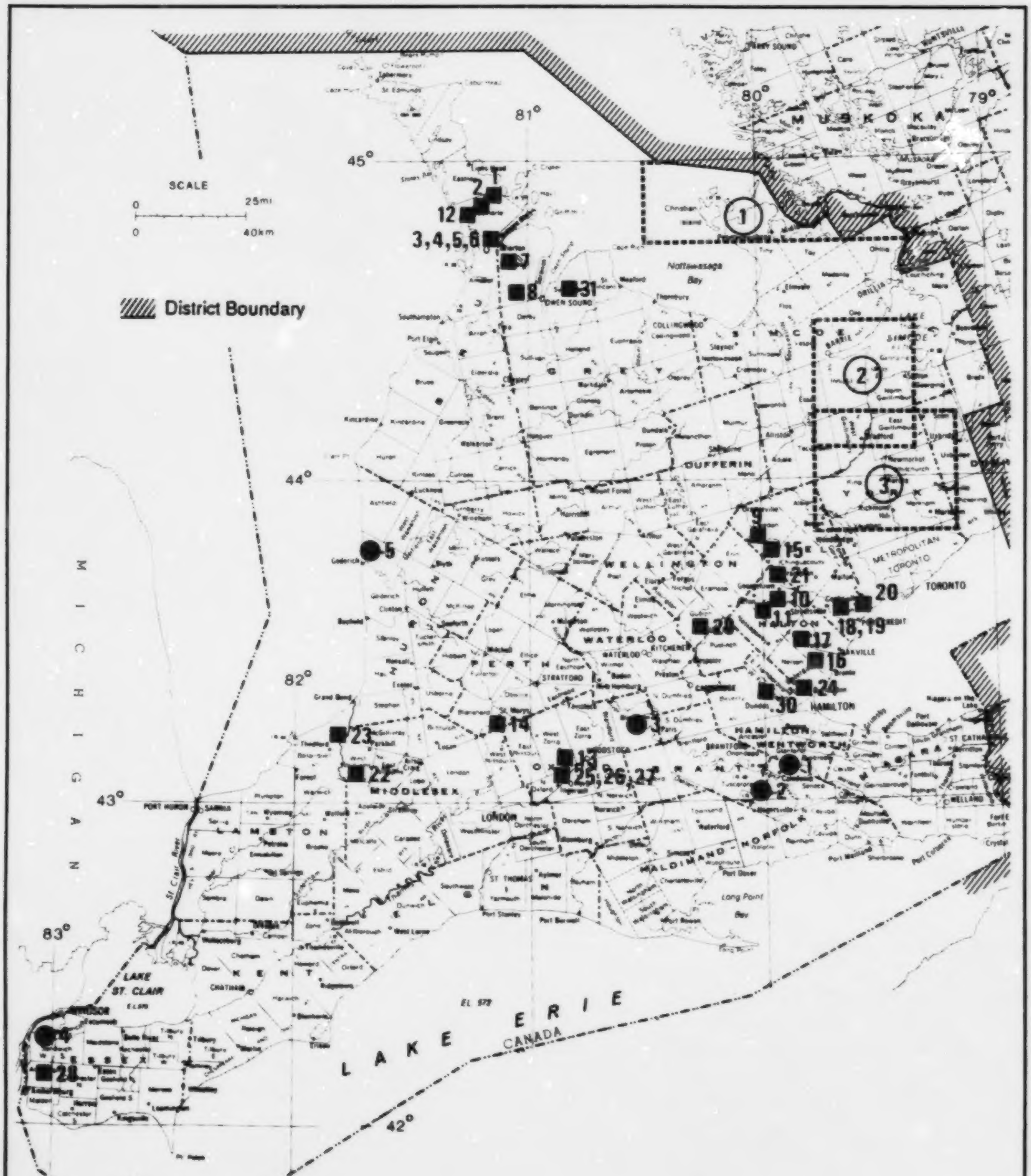
Completed projects included a report on existing information for high-purity limestone and dolostone resources in southern Ontario and compilation of mineral resource maps and accompanying text for land-use planning in the district. D. Cardelli completed a data report on kyanite, sillimanite, wollastonite and silica deposits in southern Ontario and evaluated their potential for use in white architectural cement under a Canada-Ontario-Federal White Cement, Section 25 project.

Staff reviewed land-use plans related to waste disposal and provided geoscience information for coal-ash disposal and mine-subsidence monitoring. The Resident Geologist provided expert witness testimony on sandstone building stone resources to the Niagara Escarpment Commission 5 year plan review hearings in November.

The Southwestern District hosted the Director's and Resident's meeting in February. A half-day symposium on mineral resources of southwestern Ontario and a trip to the Goderich Salt Mine of Sifto Canada Inc. were arranged in conjunction with the meeting.

Office staff arranged field visits to the Goderich Salt Mine of Sifto Canada Inc. and the Canada Gypsum Company Mine at Hagersville for the Minister of Mines and staff in April and July respectively.

Geological education initiatives included talks by the staff geologist to local rock and mineral clubs, leading a glacial geology field trip to the Lake Ontario bluffs for a 2nd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SIMCOE
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DUFFERIN
WELLINGTON
WATERLOO
PERTH
MIDDLESEX
LAMBTON
KENT
ESSEX
HALDIMAND-NORFOLK
HAMILTON-WENTWORTH
BRANT
METROPOLITAN TORONTO
TORONTO
HAMILTON
LONDON
KITCHENER
STRATFORD
OWEN SOUND
MICHIGAN
LAKE ERIE
LAKE ST. CLAIR
CANADA
Nottawasaga Bay
Long Point Bay
45°
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Figure 20.1
Southwestern Resident
Geologist's District

EXPLANATION

Location of Ontario Geological Survey Field Projects, 1991

① Quaternary Geology - Christian Island, Penetanguishene and Gravenhurst Areas
② Quaternary Geology - Barrie Area
③ Overburden Sounding - Regional Municipality of York

● Producing Mines, 1991

Gypsum

1. Caledonia No. 3 - Domtar Inc.
2. Haldimand - Canadian Gypsum
3. Blandford/Blenheim Twp. - Westroc Industries

Rock Salt

4. Windsor - Canadian Salt Company
5. Goderich - Sifto Canada Inc.

■ Producing Quarries, 1991.

1. **Albemarle Twp.** - Adair Marble Quarries Division,

Arriscraft Corporation

2. Albemarle Twp. - Emerson McLay
3. Amabel Twp. - Amsen Quarry Limited
4. Amabel Twp. - Ebel
5. Amabel Twp. - Owen Sound Ledgerock Limited
6. Amabel Twp. - Ross Producing Quarries, 1991 -cont'd.
7. Keppel Twp. - McCartney
8. Keppel Twp. - Owen Sound Ledgerock Limited
9. Caledon - Deforest Bros. Quarry Limited
10. Halton Hills - Hilltop Stone and Supply
11. Halton Hills - Rice and McHarg Quarries Limited
12. Albemarle Twp. - Amsen Quarry Limited

Cement Limestone (Clay, Shale)

13. Zorra - Lafarge Canada Inc.
14. St. Mary's - St. Marys Cement Company

Clay Products (Shale)

15. Caledon - Brampton Brick
16. Burlington - Canada Brick
17. Milton - Canada Brick
18. Mississauga/Streetsville - Canada Brick
19. Mississauga/Streetsville - Canada Brick
20. Mississauga/Cooksville - Canada Brick
21. Halton Hills - Martin Clay Products
22. West Williams Twp. - Martin Clay Products
23. Bosanquet Twp. - G. Coultis
24. Aldershot - Canada Brick

Chemical - Metallurgical - Pulverized Stone (Limestone, Dolostone)

25. Zorra Twp. - BeachviLime Limited
26. Zorra Twp. - BeachviLime Limited
27. Zorra Twp. - Stelco
28. Anderdon Twp. - General Chemical
29. Guelph - Guelph Do Lime Limited
30. Flamborough - Steetley Lime and Aggregates
31. Sydenham Twp. - Owen Sound Dolomite

year geology class from the University of Guelph and participation in an Environment Day conference organized by London area high school students. Office staff met with a representative of the London Board of Education to discuss geological education opportunities within the classroom.

The Resident Geologist led a tour to the Whirlpool Formation sandstone quarries in July for a group of Canadian architects advising the United Nations on preservation and/or restoration of historical monuments and sites. The Staff Geologist accompanied a building stone delegation from Britain to Arriscraft Corporation, Cambridge and Hilltop Stone and Supply, Georgetown, in August.

The Staff Geologist attended a short course on "Ground Subsidence and Analysis for Salt Caverns" on May 24 and also participated in a core workshop on the "Salina" Group (Silurian) of southwestern Ontario, on May 13. The former course was arranged by the Petroleum Resources Section of the Ministry of Natural Resources, London and the latter by the Canadian Sedimentology Research Group. The Staff Geologist also attended the annual meeting of the Geological Association of Canada in Toronto, May 27–29.

The Resident and Staff Geologist attended the Prospectors and Developers convention in Toronto, March 25–27.

RESEARCH BY RESIDENT OFFICE STAFF

Woodbridge - ANSI Site Study, Toronto

Construction of Highway 407 and associated access roads through the Woodbridge area immediately north of Toronto will directly impact upon the Woodbridge Area of Natural and Scientific Interest (ANSI) site. The Woodbridge site provides one of the most important and complete Quaternary reference sections in southwestern Ontario.

At the request of the Ministry of Transportation (MTO), Central Region, a limited program of overburden drilling was completed in the immediate vicinity of the existing exposure. The objective of this study was to identify and establish the lateral continuity of the various Quaternary units within the immediate study area so as to identify potential locations for possible establishment of a suitable replacement exposure.

A total of six boreholes were completed and logged. Additional samples and logs from an MTO geotechnical drilling program were examined to provide further information. Core logging revealed that the most complete sequence of stratigraphic units occurs in those boreholes located in the immediate vicinity of the existing exposure.

Rapid lateral changes in stratigraphy and thickness of individual geologic units were noted. The Illinoian age York Till was observed in five of the six completed boreholes, at depths ranging from 38 feet to 57 feet 6 inches below ground surface. A sand-gravel-till complex overlying the York Till was encountered in five of the six boreholes.

At three locations a peculiar greenish diamiction was encountered above the York Till and/or sand-gravel-till complex. This unit was previously identified at the Woodbridge cut and was informally termed the Green Till (White 1975). The origin of this unit has never been fully clarified, however, it may be that this unit is Illinoian in age and stratigraphically associated with the York Till and associated drift complex.

Overlying the York Till, Green Till? and/or sand-gravel-till complex, the Early Wisconsinan Scarborough Formation was identified. This primarily silt-rich unit contains abundant shell and organic matter fragments. The thickness and lithology of this unit varies greatly within the study area and appears to be restricted to the immediate vicinity of the existing exposure.

Overlying the Scarborough Formation, a thin layer of Early Wisconsinan Sunnybrook Till was encountered in five of six boreholes.

No Middle Wisconsinan units nor any Late Wisconsinan till units beneath the Halton Till unit were encountered in any of the boreholes. A Late Wisconsinan till, the Halton Till, was encountered in all boreholes.

A complex of gravelly sands, sands and silts underlying the Halton Till was encountered in three boreholes. In one borehole this sediment complex reached nearly 40 feet in thickness. This unit had previously been identified in the area as a Late Wisconsinan glaciofluvial unit (White 1975).

A Late Wisconsinan drift unit (Wildfield Till) caps the stratigraphic sequence in all boreholes except one where the drift is overlain by alluvial and colluvial sediments. The results of this study have been presented to MTO for review and consideration regarding minimizing impact on the exposure. At the time of writing MTO announced that they had suspended activity related to the current design of the interchange and access roads affecting the Woodbridge ANSI.

An environmental impact review of proposed design changes will be conducted before highway construction resumes.

Lake Simcoe Area Mineral Resource Potential

Middle Ordovician limestones of the Lake Simcoe area currently provide a major source of crushed stone aggregate in the province. Other current and past uses include building stone, lime, and cement manufacture.

In 1990, the Ontario Geological Survey initiated a multi-year project to map the Paleozoic geology of the Lake Simcoe area at a scale of 1:50 000. Map areas to be covered include the National Topographic System map sheets of Barrie (31 D/5), Beaverton (31 D/6), Lindsay (31 D/7), Fenelon Falls (31 D/10), Orillia (31 D/11), Elmvale (31 D/12), Penetanguishene (31 D/13) and Christian Island (41 A/16). The project will also assess aggregate suitability, with a strong emphasis on identifying areas subject to alkali-carbonate reactivity.

In conjunction with this project, the Southwestern District has initiated a study to assess mineral resource potential for the area. Commodities under study include: 1) chemical stone forcement, lime and pulverized stone products; and 2) building stone, high specification construction aggregates and sands from surficial sources for special industrial applications. The study will also outline resource areas of most value to facilitate protection from incompatible land uses in planning studies.

In 1990 a reconnaissance survey of the area was conducted. Important geologic sections were examined to provide a background to the stratigraphy of the area. In addition, data on glacial overburden thickness for the region was compiled.

Field investigations in 1991 concentrated on those regions of bedrock outcrop and thin drift cover in the western part of the study area. Where bedrock outcrops were found they were examined to establish stratigraphic units as defined by Liberty (1969). For the purposes of this investigation the stratigraphic nomenclature scheme of Liberty (1969), with modifications by Russell and Telford (1983), was used. Williams (1991) has suggested revisions to this scheme, based on field investigations of the Paleozoic strata in southeastern Ontario. Armstrong (1990) also noted uncertainties in stratigraphy, including the apparent lack of consistent contacts between the Shadow Lake, Gull River and Bobcaygeon Formations.

Following establishment of stratigraphic units, notes on strata bed thickness, lithology, colour, consistency and jointing pattern were taken where possible. This visual description provides information needed to assess rock units for building stone potential. Additionally, individual rock units were selectively sampled for geochemical analyses. By sampling in this manner it is hoped that regional geochemical trends across the project area may be established. This will assist in defining rock source areas with specific geochemical traits required for various products.

The oldest Paleozoic strata in the project area are the red and green shales, sandstones and conglomerates of the Shadow Lake Formation. Overlying the Shadow Lake Formation are the predominantly carbonate strata of the Simcoe Group.

The oldest unit of the Simcoe Group is the Gull River Formation. This formation consists mainly of micritic to fine-grained limestones, and dolostones. Shale partings are locally common. Overlying the Gull River Formation are fossiliferous, thicker bedded, coarser grained limestones of the Bobcaygeon Formation.

The Bobcaygeon Formation is overlain by the interbedded shales and bioclastic limestones of the Verulam Formation. The Lindsay Formation has been subdivided into two members; 1) the lower member a nodular limestone with thin shale partings, and 2) an upper member (Collingwood Member) of black calcareous shale.

The Paleozoic succession throughout the study area exposes progressively younger strata to the south and southwest. Often, more resistant units cap small, generally northward-facing escarpments which have developed.

The following observations are made specifically for the western part of the study area which comprises the Penetanguishene (31 D/13), Elmvale (31 D/12) and Orillia (31 D/11, western half) map sheets. Paleozoic strata within these map areas is often buried by a thick glacial sediment cover. Small areas of Paleozoic outcrop may be found, along the south shore of Georgian Bay north of Port McNicoll, Victoria Harbour and Waubaushene. A thin belt of bedrock outcrop and thin drift cover extends eastward from Coldwater to the north end of Lake Couchiching. Bedrock outcrop also occurs in that area between the eastern shore of Lake Couchiching and the western shore of Lake St. John.

East of Highway 169 large areas of bedrock outcrop occur. From a resource assessment viewpoint, the following preliminary notes can be made for the area investigated during 1991. In the past, building stone was extracted from parts of the lower and middle members of the Gull River Formation and from parts of the lower member of the Bobcaygeon Formation. Currently only the Bobcaygeon Formation is utilized to produce flagstone.Thick-bedded, greenish-coloured dolomitic limestone layers from the lower member of the Gull River Formation were in the past quarried to produce various building stone products. Sources of this stone, known as "Rama Stone", are generally restricted by a thick cover of Paleozoic strata. However potential sources may exist in two quarries, the Fowler (Woods) Quarry and MTO Coldwater Quarry where overlying Paleozoic strata have been removed to produce crushed stone aggregate. Thick beds of the desired Rama stone are known to exist immediately below the floor of these quarries. If blasting has not overly fractured these layers, then a ready source of stone is potentially available. A light cream-coloured zone of thick-bedded micritic limestone in the middle member of the Gull River Formation was previously quarried for various building stone products. This attractive stone known as "Longford Stone" may be seen in many buildings of the Orillia area. The traditional source for this stone was the Longford Mills area on Lake St. John. Potential sources of this stone still exist, however, further assessment work is needed to establish overburden thickness and continuity of favourable beds.

As previously noted, large tracts of Paleozoic bedrock with thin or little glacial sediment cover exist. Quarries for crushed stone aggregate are in production and investigations for others are planned. Suitable thicknesses of desired strata, of Bobcaygeon Formation and upper and middle members of the Gull River Formation, are restricted to the southern part of the identified thin drift area stretching from Coldwater to Lake Couchiching and the region surrounding the existing Fowler (Woods) Quarry on Lake St. John.

Resource areas suitable for chemical, metallurgical or cement stone are sketchy at present as, at the time of writing, geochemical analyses for selected samples have not been completed. Past testing (Goudge 1938; Hewitt 1960) has indicated that strata of the middle and upper members of the Gull River Formation and lower member of the Bobcaygeon Formation are potential sources of high-purity limestone. New geochemical information will assist in identifying these sources.

Geochemical Analyses of Southwestern Paleozoic Carbonates

Limestone and dolostone resources play an important role in the province's industrial economy. Uses include cement, lime, chemical and metallurgical stone, building stone, pulverized stone, fillers and extenders, and crushed stone aggregates.

To assist in the identification of potential resources of limestone and dolostone for specialty products, a geochemical assessment of various Paleozoic carbonate strata was initiated in 1990.

Rock units selected for study included the Middle Silurian Guelph and Lockport/Amabel Formation dolostones and the Middle Devonian limestones of the Detroit River Group and Dundee Formation. So as to allow for the geochemical evaluation of similar geologic units over the widest area possible, rock samples were obtained from quarry sections, natural outcrops and drill core.

Quarries sampled within the Guelph Formation included those at Dundas and Guelph. Lockport samples were obtained at Dundas. Samples of the Detroit River Group were obtained from active and inactive quarries at St. Marys, Woodstock, Windsor, Amherstburg and Teeswater. Dundee Formation limestone samples were obtained at St. Marys and Amherstburg.

Core from West Luther Township provided samples of the Guelph Formation. Samples of the Lockport/Amabel dolostone were obtained from cores drilled in Keppel and Euphrasia townships. Detroit River Group samples were collected from cores drilled at Ingersoll and from petroleum wells drilled in Chatham, Essex County and Aldborough Township.

Rock outcrops at Formosa and Walkerton were sampled to obtain examples of the Formosa Reef Limestone, an isolated reefal unit of the Detroit River Group.

Samples were submitted for the determination of major elements. Selected samples were chosen for analyses of Pb, Zn, Ni, Cu and Cr.

The following notes will provide a brief overview of results to date. Geochemical results from samples of the Guelph Formation obtained at Dundas, Guelph and West Luther Township, north of Guelph, indicate that the rock unit is, in these areas at least, very pure dolomite throughout the vertical sampling interval. Typical percentages of CaO and MgO are greater than 30.0% and greater than 21.0% respectively. Total impurities $SiO_2 + Al_2O_3 + Fe_2O_3$ are typically less than 1.0%.

Analytical results for the Amabel/Lockport Formations from samples collected at Dundas and for the townships of Keppel and Euphrasia indicate these samples are generally very pure dolomites, however, not as consistently pure as the Guelph Formation samples. Thick intervals of pure dolomite are present at Dundas and in Euphrasia Township. Samples from Keppel Township showed only a thin interval of pure dolomite. Generally, for all samples, total impurities $SiO_2 + Al_2O_3 + Fe_2O_3$ range from 0.44 to 1.55%. The less pure Keppel Township samples showed impurity levels of 8.0% to 10.0%.

Samples of the Detroit River Group indicate a wide variation in chemical purity from high-purity calcium limestone to magnesian limestones, impure dolomite and in some instances very pure dolomites. Thick deposits of high-purity calcium limestone are indicated in the Ingersoll area and to a lesser extent in the Walkerton area. Near Ingersoll the purest intervals are restricted to the Lucas Formation of the Detroit River Group. Typical values for samples of the Lucas Formation are CaO greater than 54.0% and MgO less than 0.9%. Impurities $SiO_2 + Al_2O_3 + Fe_2O_3$ range from 0.10 to 0.90%. Rare samples show total impurities exceeding 1.0%. Some samples from the core at Ingersoll show elevated levels of SiO_2 in what is interpreted to be the Lucas Formation. Values of SiO_2 range from 0.67 to 4.27%. These levels may be deleterious for some applications.

In the Walkerton area intervals of very pure calcium limestone were identified in the Formosa Reef Limestone. Some sample results also indicate the presence of dolomite-rich zones within the high-purity calcium limestone intervals. The extent and location of the dolomitic intervals will need to be outlined through further testing.

Thin intervals of high-purity calcium limestone were identified in the Amherstburg and Essex County samples. Highest purity limestone is restricted to the upper parts of the Lucas Formation. Other parts of the Lucas Formation in these areas are magnesian limestones or dolomites.

A limited number of samples from Aldborough Township indicate that the Detroit River Group is very siliceous here. No high-purity intervals were identified.

Samples of the Dundee Formation were obtained from St. Marys and Essex County. The limited sampling from these areas indicates that zones of high-purity calcium limestone are present. The drawback to the unit is the presence of undesirable

SiO_2 levels. In all samples, levels of over 1.0% were indicated. These levels may restrict this formation for some uses. Further testing is needed to determine whether zones of high-purity calcium limestone with low silica levels exist.

Results of this study to date have identified some new potential high-purity carbonate sources and shown other areas to be of low potential. Further testing is needed to determine the extent of high-purity intervals.

Additionally, testing has provided up-to-date geochemical results for a regional geochemical database.

RECOMMENDATIONS FOR EXPLORATION

As noted in last year's report, increasing awareness of environmental problems will require innovative solutions to correct pollution problems. One of the most important targets in exploration in the Southwestern District should be the location of sources of high-purity calcium limestones. Initiatives by Ontario Hydro to reduce flue gas emissions from coal-fired generating stations will require large volumes of high-purity limestone to be used in the scrubbing process. Other potential uses for high-purity calcium limestones include remediation of acid mine tailings and use in the cement, steel and chemical industries. An interesting use of high-purity calcium limestone is its apparent ability to break down polychlorinated biphenyls (PCB's) into harmless compounds. Research is currently underway in the United States to verify this.

The district has potential sources of high-purity calcium limestone in the Detroit River and Simcoe Groups. Further detailed mapping and geochemical assessment of these rock units is required.

Natural stone for building uses is an area which continues to show strong demand in the district. The Southwestern District possesses a number of rock units which have potential to produce attractive building stone products. New extraction and finishing techniques may allow previously worked rock units to be re-examined as to their viability.

Former units utilized in the district which are worth investigation include the Longford and Rama stones from the Lake Simcoe area and the Guelph, Dundee and Lucas Formations from southwestern Ontario.

ONTARIO GEOLOGICAL SURVEY ACTIVITIES

The locations of 1991 field investigations conducted by the Ontario Geological Survey in the Southwestern District are shown in Figure 20.1. The following notes provide a brief outline of each project.

1. A.F. Bajc, Engineering and Terrain Geology Section, continued Quaternary mapping (1:50 000 scale) of the Huntsville-Penetang area. A small part of this mapping project is located within the Southwestern District.

2. P.J. Barnett, Engineering and Terrain Geology Section, continued Quaternary mapping (1:50 000 scale) of the Barrie-Elmvale area.

3. Staff of the Geophysics/Geochemistry Section, continued a program of overburden sounding research and groundwater studies in the York Region.

RESEARCH BY OTHER AGENCIES

The following are brief outlines of Ontario Geoscience Research Grants provided for academic studies, relevant to the district covering the period 1991–1992.

1. F.J. Longstaffe, University of Western Ontario, continues his study on "Mineralogical and Isotopic Investigations of Clastic Diagenesis in Cambro-Ordovician Strata of southern Ontario: Implications for Paleofluid Flow and Porewater Evolution".

2. H.C. Halls, University of Toronto, continues his study "A Seismotectonic Study of Western Lake Ontario Region".

3. S.J. Haynes, Brock University, will initiate the study "Stratigraphy of the Cayugan Series, Southwestern Ontario". This study will also include information pertaining to commodity reserves (salt, gypsum) and suitability of strata for waste disposal sites.

4. J.F. Greenhouse and D.C. Nobes, University of Waterloo, will continue their study "Modification of the Shallow Reflection Seismic Method for Urban Geophysical studies in southern Ontario".

5 M. Sklash, University of Windsor, will continue his investigation "Hydrogeological Implications of Buried Eskers in Essex County".

6. D.L. Smith, Queen's University, will complete his study "The Salina Group: Relation to Guelph Reef Reservoirs, Salt Caverns and the Availability of Industrial Minerals, Southwestern Ontario".

SELECTED PUBLICATIONS RECEIVED

The following reports and maps pertaining to the Southwestern District were published during 1991 by the Ontario Geological Survey and the Ministry of Natural Resources.

Barnett, P.J. 1991. Preliminary Report on the Stratigraphic Drilling of Quaternary Sediments in the Barrie Area, Simcoe County, Ontario; Ontario Geological Survey, Open File Report 5755, 80p.

Barnett, P.J., Cowan, W.R. and Henry, A.P. 1991. Quaternary Geology of Ontario, Southern Sheet; Ontario Geological Survey, Map 2556, scale 1:1 000 000.

Carter, T.R. 1991. Oil and Gas Exploration, Drilling and Production Summary 1987; Ontario Ministry of Natural Resources, Oil and Gas Paper 10, 128p.

Churcher, P.L. and Dusseault, M.B. 1991. Clay Distribution in Carbonate Reservoirs: Examples from the Silurian of Southwestern Ontario; Ontario Geological Survey, Open File Report 5739, 221p.

Churcher, P.L., Johnson, M.D., Telford, P.G. and Barker, J.F. 1991. Stratigraphy and Oil Shale Resource Potential of the Upper Ordovician Collingwood Member, Lindsay Formation, Southwestern Ontario; Ontario Geological Survey, Open File Report 5817, 98p.

Dollar, P.S., Frape, S.K. and McNutt, R.H. 1991. Geochemistry of Formation Waters, Southwestern Ontario, Canada and Southern Michigan U.S.A.: Implications for Origin and Evolution; Ontario Geological Survey, Open File Report 5743, 72p.

Easton, R.M. and Carter, T.R. 1991. Extension of Grenville Basement Beneath Southwestern Ontario, Rock Types and Tectonic Subdivisions; Ontario Geological Survey, Open File Map 162, scale1:1 013 760.

Gupta, V.K. 1991. Shaded Image of Total Magnetic Field of Ontario, Southern Sheet; Ontario Geological Survey, Map 2587, scale 1:1 000 000.

Gupta, V.K. 1991. Vertical Magnetic Gradient of Ontario, Southern Sheet, Ontario Geological Survey, Map 2591, scale 1:1 000 000.

Gupta, V.K. 1991. Bouguer Gravity of Ontario, southern sheet; Ontario Geological Survey, Map 2595, scale 1:1 000 000.

Haynes, S.J., Hughes-Pearl, J. and Boland, R. 1991. Gypsum Deposits of Southern Ontario; Ontario Geological Survey, Open File Report 5788, 200p.

Karrow, P.F. 1991. Quaternary Geology of the Brampton Area; Ontario Geological Survey, Open File Report 5819, 136p.

Kelly, R.I. 1991. Quaternary Geology of the Chatham-Wheatley Area; Ontario Geological Survey, Open File Map 163, scale 1:50 000.

Nobes, D.C. and Warner B.G. 1991. The Characterization of Bogs Using Ground Penetrating RADAR, Ontario Geological Survey, Open File Report 5778, 262p.

Ontario Geological Survey 1991. Aggregate Resources Inventory of Collingwood Township, Grey County; Aggregate Resources Inventory Paper 87, 50p.

—— 1991a. Aggregate Resources Inventory of McGillivray, East Williams and West Williams townships, southern Ontario; Aggregate Resources Inventory Paper 107, 47p.

—— 1991b. Aggregate Resources Inventory of Logan and Hibbert townships; Aggregate Resources Inventory Paper111, 65p.

—— 1991c. Aggregate Resources Inventory of the Towns of Innisfil and Bradford West Gwillimbury, Simcoe County; Aggregate Resources Inventory Paper 114, 42p.

—— 1991d. Aggregate Resources Inventory of Raleigh and Harwich townships, Kent County, Southern Ontario; Aggregate Resources Inventory Paper 126, 55p.

—— 1991e. Aggregate Resources Inventory of St. Vincent Township, Sand and Gravel; Ontario Geological Survey, Open File Map 147, scale 1:50 000.

—— 1991f. Aggregate Resources Inventory of St. Vincent Township, Bedrock Resources; Ontario Geological Survey, Open File Map 148, scale 1:50 000.

—— 1991g. Aggregate Resources Inventory of Euphrasia Township, Sand and Gravel; Ontario Geological Survey, Open File Map 149, scale 1:50 000.

—— 1991h. Aggregate Resources Inventory of Euphrasia Township, Bedrock Resources; Ontario Geological Survey, Open File Map 150, scale 1:50 000.

—— 1991i. Aggregate Resources Inventory of St. Edmunds and Lindsay townships, Sand and Gravel; Ontario Geological Survey, Open File Map 151, scale 1:50 000.

—— 1991j. Aggregate Resources Inventory of St. Edmunds and Lindsay townships, Bedrock Resources; Ontario Geological Survey, Open File Map 152, scale 1:50 000.

—— 1991k. Aggregate Resources Inventory of Eastnor and Albemarle townships, Sand and Gravel; Ontario Geological Survey, Open File Map 153, scale 1:50 000.

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21. Petroleum Resources Section, Ministry of Natural Resources—1991

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INTRODUCTION

The boring, drilling and deepening of wells into potentially oil- and gas-bearing strata in Ontario is regulated under the authority of the Petroleum Resources Act R.S.O. 1980. The Petroleum Resources Section of the Ontario Ministry of Natural Resources in London administers and enforces the regulations made under the Act and, in addition, is the principal source of information on oil, gas and brine resources in the province. The information on industry activity summarized here is derived principally from information submitted by licensed operators to the Ministry of Natural Resources to meet regulatory requirements. Most information on drilling of development and service wells is confidential for a period of 30 days after drilling reaches total depth. The confidentiality period for exploratory wells is one year. Consequently only a limited amount of information on exploratory drill holes is available for release at the time of writing.

This report is a preliminary summary of the results of exploration for and development of oil and natural gas in Ontario in 1991. Results of drilling in 1991 are up-to-date as of January 13, 1992. Preliminary production totals are also presented. Final totals for drilling and production will not be available until April 1992. A summary of final 1990 results are presented for comparison purposes.

OIL AND GAS PRODUCTION

Oil production in Ontario in 1991, up to and including December 31, 1991, totalled 235 249.7 m^3, a 5% decline from the record total of 247 406.8 m^3 of oil produced in 1990.

Annual oil production has tripled since 1983, due entirely to production from newly discovered Ordovician pools in Essex and Kent counties. Ordovician pools accounted for 74.7% of the total oil production of Ontario in 1989, compared to only 3.6% in 1982. Kent County produced the largest proportion of Ontario's oil production in 1990. On a pool basis, the Romney 6-13-III pool in Kent County was the largest producer, with recorded production of 40 010.0 m^3 of oil (251 660 bbl) from seven active wells in 1990.

Preliminary totals for production of natural gas in Ontario are not available. Total production in 1990 amounted to 467 million m^3 (16.5 bcf), a 5% decline from the previous year. Approximately 75% of the gas was from wells on Lake Erie.

According to data supplied by Esso Resources Canada Limited the average price received by Ontario producers for crude oil in 1990 was \$176.84/m^3 (\$28.11/bbl) compared to \$141.42/m^3 (\$22.48/bbl) in 1989. This increase was due to short-term increases in oil prices caused by the invasion of Kuwait by Iraq and the ensuing Gulf war. Ontario oil prices peaked at \$295.68/m^3 on October 9, 1991. Prices have declined considerably since that time. The posted price offered for Mersea Township crude oil, an Ontario crude used for reference purposes, as of October 1, 1991 was \$156.59/m^3.

The weighted average price paid to Ontario producers of natural gas by Union Gas Limited in 1990 was \$99.95/103 m^3 (\$2.83 /mcf), compared to \$100.98/103 m^3 (\$2.86/mcf) in 1989. Comparable figures for 1991 are not yet available.

EXPLORATION AND DEVELOPMENT ACTIVITY

Exploration for and development of oil and gas in Ontario in 1991 remained at about the same level as in 1990, but drilling of service wells declined to about one-third the rate of the previous year. Drilling results had been reported for a total of 110 wells at the time of writing, compared to 120 in 1990. These consisted of 49 exploratory wells, 50 development wells and 11 service wells. The exploratory drilling resulted in 15 wells completed as gas producers, two wells completed as oil producers and three wells completed to produce both oil and gas (Table 21.1, Figure 21.1). Development drilling resulted in five wells reported to be oil producers and 25 as gas producers.

As in the previous seven years, exploration for and development of Ordovician oil reservoirs was the highlight of drilling activity in Ontario, with drilling reported to be complete at 17 exploratory wells and 12 development wells. In other exploratory drilling there were: one test of Cambrian targets, 16 Guelph–Salina and 15 Clinton–Cataract targets. In development drilling, Clinton–Cataract reservoirs were the principal target for 27 wells, mostly on Lake Erie, five in Guelph– Salina reservoirs, four in Cambrian reservoirs and two in Devonian reservoirs.

The Ordovician exploratory drilling is reported to have resulted in two new oil producers, one gas producer and two wells capable of production of both oil and natural gas, while the development drilling resulted in three new oil producers and one gas producer. As in the previous year, Essex County

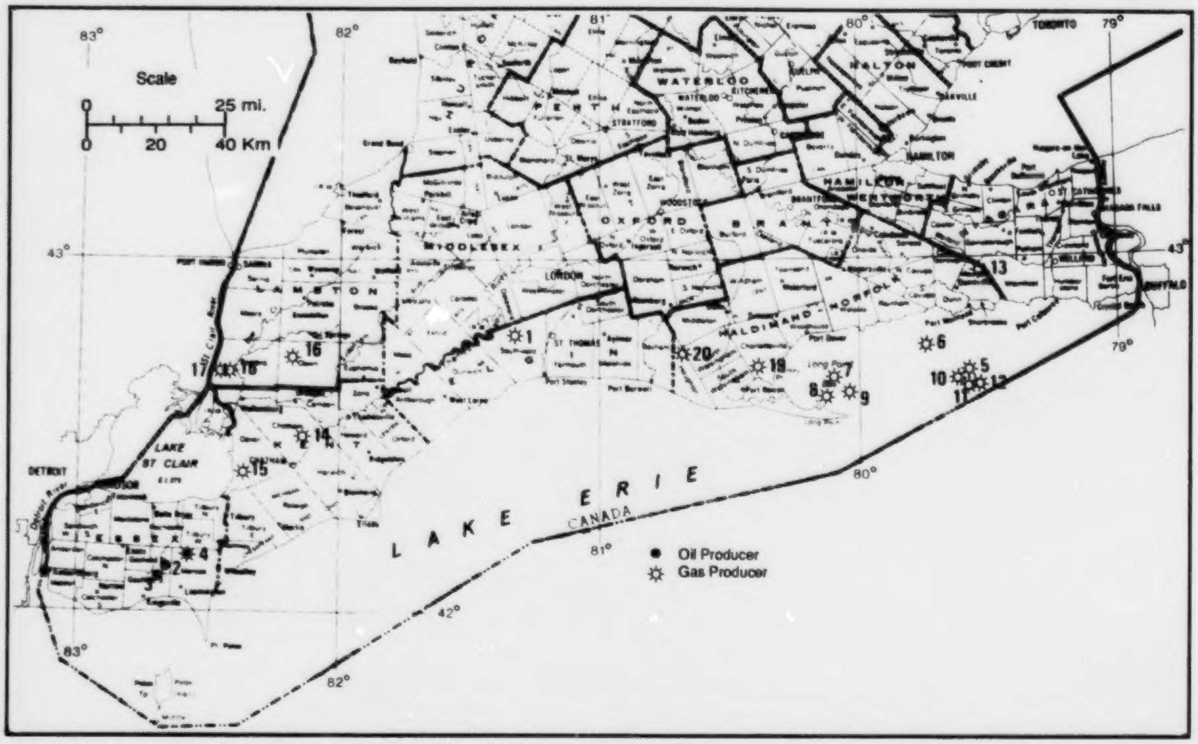

Figure 21.1. Location of successful exploratory wells in southwestern Ontario in 1991.

was the focus of most of the Ordovician exploratory drilling, with wells drilled in Gosfield North, Gosfield South, Mersea and Tilbury West townships. Three of these wells resulted in new discoveries or extensions to previously known pools. Judo 8 Mersea 5-10-IX was successfully completed as a combined oil and gas producer in a new pool discovery on the northwesterly extension of the fault system that hosts the Mersea 8-16-VIII oil pool. Telesis 34537 Gosfield North 6-23-VI was completed as an oil producer in an exploratory extension to the Gosfield North 2-21-VI oil pool. Ram/BP Telesis 19 Deviated 1 Gosfield South 4-258-STR was completed as an oil producer in a new pool discovery southwest of the Gosfield North 2-21-VI pool. In Kent County an extension to the Dover 7-5-V E oil and gas pool was discovered by PPC/Ram 22 Dover 2-1-V E which was completed as an oil and gas producer. Unsuccessful exploratory tests were drilled in Romney Township in Kent County and in Moore and Sombra townships in Lambton County as exploration interest in the Ordovician play slowly broadens beyond its center in Mersea, Romney and Dover townships.

Ordovician development wells were drilled in Essex, Elgin, and Kent counties. In Essex County two wells were completed as oil producers in the Mersea 6-23-VII pool. In Kent County one development well was completed as an oil producer in the Romney 3-8-II pool and one well was completed as a gas producer in the Dover 7-5-V E oil and gas pool.

One Cambrian exploratory test was drilled in 1991. Malahide Pete Southwold 8-22-NBTR was successfully completed as a gas producer in a new pool discovery in an unexplored area east of the Willey oil pool. There were four Cambrian development wells. One well in the Willey oil pool was completed as an oil producer and three wells in the Innerkip gas and oil field were completed as gas producers.

Exploratory drilling of Silurian Guelph reef targets and associated dolomitized zones in the Salina A-1 and A-2 units resulted in two new gas wells and one oil and gas well. Development drilling resulted in two gas producers. Exploratory drilling of Silurian Clinton–Cataract sandstone targets resulted in 11 new gas wells while development drilling resulted in 19 gas producers. One Devonian development well was completed as an oil producer.

The Sarnia 1-8-A Pool, a depleted natural-gas reservoir in a Guelph Formation pinnacle reef, was recommended for designation as a natural gas storage pool in a report by the Ontario Energy Board dated October 29, 1991, after a three-day hearing held in Sarnia from September 4 to 6. The hearing dealt with three applications; E.B.O. 172—request for designation as a natural gas storage area and permission to inject, store and remove gas, E.B.L.O. 239—leave to construct natural gas pipelines and E.B.R.M.—referral of applications made to the Ministry of Natural Resources for permits to drill natural gas storage wells in the pool. All the applications were approved

Table 21.1. Successful exploratory wells in southwestern Ontario, 1991.

Abbreviations

OP..Oil Producer
GP..Gas Producer
NPW.....................................Exploratory Well

Map No.	Latitude Longitude	Well Name	Target	Metres Drilled	Class Status	Completion Date
ELGIN COUNTY						
1	42°45'37" 81°19'42"	Malahide Pete Southwold 8-22-NBTR	Cambrian	1085.8	NPW GP	91.04.04
ESSEX COUNTY						
2	42°06'15.8" 82°39'11.8"	Telesis 34537 Gosfield N. 6-23-VI	Ordovician	800.0	NPW OP	91.09.16
3	42°04'45" 82°40'01"	Ram/BP Telesis 19 Gosfield S.4-258-STR	Ordovician	858.0	NPW OP	91.05.23
4	42°08'19" 82°33'56"	Judo 8 Mersea 5-10-IX	Ordovician	798.0	NPW OP,GP	91.08.02
HALDIMAND						
5	42°40'08.8" 79°34'51"	Pembina Lake Erie 39-Y-3	Clinton–Cataract	410.7	NPW GP	91.05.23
6	42°44'08.3" 79°44'53.1"	Pembina Lake Erie 41-E-3	Clinton–Cataract	362.5	NPW GP	91.08.03
7	42°39'45" 80°06'15.1"	Pembina Lake Erie 64-B-1	Clinton–Cataract	399.3	NPW GP	91.08.16
8	42°35'09.3" 80°07'13"	Pembina Lake Erie 64-W-4	Clinton–Cataract	468.1	NPW GP	91.08.10
9	42°36'44.7" 80°01'45"	Pembina Lake Erie 65-S-2	Clinton–Cataract	435.0	NPW GP	91.08.03
10	42°39'43.1" 79°36'23"	Pembina Lake Erie 70-B-1	Clinton–Cataract	420.3	NPW GP	91.06.17
11	42°38'42.8" 79°33'48.7"	Pembina Lake Erie 71-G-2	Clinton–Cataract	447.0	NPW GP	91.06.10
12	42°38'42" 79°32'45.3"	Pembina Lake Erie 71-H-2	Clinton–Cataract	444.0	NPW GP	91.05.29
13	42°57'17.5" 79°32'08"	Robins 1 Moulton 3-5-IV	Clinton–Cataract	202.7	NPW GP	91.09.30
KENT						
14	42°28'31.5" 82°08'16"	Torgary et al. No.1 Chatham 7-14-III	Salina–Guelph	488.0	NPW GP	91.01.21
15	42°22'05" 82°22'56"	PPC/Ram 22 Dover 2-1-VE	Ordovician	1132	NPW GP	91.02.01
LAMBTON						
16	42°42'46" 80°02'28"	Perma et al. Dawn 2-26-XII	Salina–Guelph	540.6	NPW GP	91.02.27
17	42°38'42" 82°27'18"	Kinderhook No.3 Sombra 8-2-VI	Salina–Guelph	612.6	NPW OP,GP	91.10.16
18	42°38'41.5" 82°25'45"	Torgary et al. No.2 Sombra 7-6-VI	Ordovician	963.0	NPW GP	91.07.05
NORFOLK						
19	42°41'46" 80°24'05"	Metalore 83 Charlotteville 3-5-I	Clinton–Cataract	427.3	NPW GP	91.11.06
20	42°42'27" 80°39'54"	Norfolk 90-3 Houghton 4-17-II	Clinton–Cataract	418.5	NPW GP	91.11.29

with only a minor change to the proposed boundary of the designated storage area. Ownership, use and development of the pool is a joint-venture operation shared equally by Union Gas Limited and Dow Chemical of Canada Limited. Union Gas staff at the hearing estimated that the pool would have a working capacity of 174.0 million m^3 (6.14 bcf) when delta pressured to 10 310 kPa (1495 psi). The joint venture plans to drill four storage wells to develop the pool in 1992 and will convert two existing wells into observation wells.

There are now 21 former gas pools in the subsurface of southwestern Ontario which have been designated as natural-gas storage pools by the Ontario Energy Board. Nineteen were in operation at the time of writing. Winter demand for natural gas in Ontario exceeds the capacity of the natural gas pipelines from western Canada. The shortfall is made up by injection of natural gas into the storage pools in the summer and withdrawal of the stored gas in winter to meet winter peak demand. Total working capacity of the active storage pools in Ontario is approximately 5.5 billion m^3 (193 bcf).

STAFF ACTIVITIES

Geological program staff employed at the Petroleum Resources Laboratory during the year consisted of T. Carter, Senior Petroleum Geologist, M. Campbell, Petroleum Resources Laboratory Technician and M. Bernardo, Clerk Typist. W. Harvey was employed during the summer as a Geological Assistant on the Experience '91 program and for the fall and winter as a Laboratory Technician processing cuttings samples. M. Cummings was employed during the summer as a Laboratory Technician responsible for slabbing and boxing of drill core received during 1991.

Engineering and administrative staff include: P. Palonen, Provincial Petroleum Supervisor; R. Rybansky, Chief Engineer; E. Habib, Onshore Engineer; J. Manocha, Brine Resources Engineer; C. Owen, Systems Analyst; F. McKeon, Data Processing Technician; I. Cameron, Draftsperson; S. Shanks, Program Secretary and G. Stephenson, Data Processing Technician.

Petroleum Resources inspectors are responsible for enforcement of the Petroleum Resources Act and associated regulations. M. Hunter, Deputy Chief Inspector, L. Chambers and B. Lewis are located in the Simcoe District office. B. Sealey and K. McConnell operate out of the Chatham District office. J. Chivers operates out of the Petroleum Resources Laboratory.

Geological staff continued their efforts to encourage investment in Ontario's oil and gas industry by providing geological information, advice and interpretations. In addition to Ontario-based companies, numerous inquiries and/or office visits were made by industry representatives from Calgary, Michigan, Ohio, New York and Texas. There was also an increase in the number of requests for subsurface information from water-well drillers and environmental-geology consultants.

The authors, T.R. Carter, acted as the chairperson of the technical committee for the 30th Annual Conference of the Ontario Petroleum Institute which was held in London October 9 to 11, 1991. A total of 15 papers were presented in four sessions on Geology/ Geophysics, Computer Applications, Technology and Techniques and Petroleum Industry History. Carter presented a paper in the Geology/Geophysics session entitled "Dolomitization patterns in the Salina A-1 and A-2 units, Sombra Township, Ontario". The paper documented the geological associations of dolomite in these two strata in the subsurface of Sombra Township in Lambton County, and was the result of interpretation of subsurface data collected over a span of five years.

A data file and explanatory notes entitled "Sombra Subsurface Geology" was released on November 4, 1991. The data file is provided as both an ASCII format and as a dBase IV® dbf file on one high-density 3.5 inch diskette. The data consists of a new set of consistently picked formation-top depths and calculated elevations and thicknesses for all oil and gas wells drilled in Sombra Township to the end of 1986. Also included are the well-permit number and latitude and longitude. Formation-top picks are included for the following formations: Drift, Dundee, Columbus, Bass Islands, C Shale, B Marker, B Equivalent, B Salt, B Anhydrite, A-2 Carbonate, A-2 Shale, A-2 Salt, A-2 Anhydrite, A-1 Carbonate, A-1 Anhydrite, Guelph, Goat Island, Gasport and Rochester. Also included is the weighted % dolomite content for each of the A-1 and A-2 Carbonate units. This file includes all the data generated by the dolomite study of Sombra Township. Similar files, with the exception of dolomite data, will be released for all the remaining townships in Lambton County in the first half of 1992.

DRILL-SAMPLE STORAGE

Routine collection, processing and cataloguing of core and drill-cuttings samples from all wells permitted under the Petroleum Resources Act continued in 1991. Important new additions to the core collection in 1991 are listed on the following page in table 21.2.

RECOMMENDATIONS FOR EXPLORATION

Ordovician oil reservoirs remain the most attractive targets for exploration in southwestern Ontario. These reservoirs occur in dolomitized limestones associated with vertical faults in the Trenton and Black River groups. Since 1982, most of the new Ordovician discoveries have been in Mersea Township in Essex County or in Romney Township and Dover Township in Kent County. In 1991 a new Ordovician oil pool was discovered in Gosfield North Township in Essex County and a

Table 21.2. Additions to the core collection in 1991.

Core No.	Location	Formations Cored
1008	Orillia 12-X	Gull River to Precambrian
1009	Orillia 12-X	Gull River to Precambrian
1010	Charlotteville 21-I	Precambrian
1011	Lake Erie 95-H-1	Reynales-Grimsby
1012	Lake Erie 24-V-1	Cabot Head-Queenston
1013	Lake Erie 39-Y-3	Whirlpool-Queenston
1014	Enniskillen 1-15-VI	Guelph
1015	Colchester S. 8-16-V	Cobourg-Verulam
1016	Lake Erie 124-P-3	Thorold-Grimsby
1017	Lake Erie 155-E-3	Reynales-Grimsby
1018	Sandwich W. Fighting Is.	Lucas-B Anhydrite
1019	Tay 10-XIV	Precambrian
1020	Sandwich W. Fighting Is.	Lucas-E Unit
1021	Lake Erie 124-F-2	Thorold-Grimsby
1022	Lake Erie 126-A-4	Thorold-Grimsby

new gas pool in Sombra Township in Lambton County, broadening the area of Ordovician production. All of Essex County and Kent County and possibly the western portion of Elgin County is prospective for additional Ordovician oil production. The area to the north and east is virtually unexplored for Ordovician potential and is considered to be very prospective for natural gas.

There is an increasing amount of exploration for Silurian reef reservoirs and for traps formed by dolomitized zones in the Salina A-1 and A-2 Carbonate units, particularly in Lambton County. This increase is due in part to some recent successes and to the increasing value of the reef reservoirs for use as natural-gas storage pools after depletion.

There has been a marginal increase in exploration for Cambrian oil and gas pools in the past three years due to successful activity centred around the Innerkip oil and gas field. Cambrian strata have very large undiscovered potential in southern Ontario and are expected to become the next major oil and gas play in Ontario when the current interest in Ordovician pools declines.

RESEARCH BY OTHER AGENCIES

One BSc and two MSc theses were completed on topics relevant to oil and gas exploration in southwestern Ontario in 1991 (Hamilton 1991; Middleton 1991; Rouble 1991). Work continued on three projects funded by the Ontario Geoscience Research Grant Program:

1. The Salina Group: relation to salt caverns, reef reservoirs and industrial minerals, southwestern Ontario; L. Smith, Queen's University, Kingston.

2. Mineralogical and isotopic studies of diagenesis in Cambro–Ordovician sedimentary rocks, southwestern Ontario; M.A. Wadleigh and F.J. Longstaffe (Western), R.H. McNutt (McMaster), and S.K. Frape (Waterloo).

3. Stratigraphy of the Cayugan Series, southwestern Ontario; S.J. Haynes, Brock University, St. Catharines.

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Hamilton, D. 1991. Styles of reservoir development in Middle Devonian carbonates, southwestern Ontario; unpublished MSc thesis, University of Waterloo, Waterloo, Ontario, 229p.

Middleton, K. 1991. Fracture-related diagenesis of Middle Ordovician carbonate reservoirs, southwestern Ontario; unpublished MSc thesis, University of Waterloo, Waterloo, Ontario, 141p.

Rouble, R. 1991. Paleoenvironmental interpretation of the Grimsby Formation (Silurian) in subsurface, eastern Lake Erie, Ontario; unpublished MSc thesis, Brock University, St. Catharines, Ontario, 91p.

Metric Conversions and Acronyms

To Convert	To	Multiply by:
thousand cubic metres (10^3m^3)	thousand cubic feet	35.315
cubic metres (m^3)	barrels (bbl)	6.290
cubic metres (m^3)	cubic feet (ft^3)	35.315
million cubic metres	billion cubic feet (bcf)	0.0353
kilopascals (kPa)	pounds per square inch (psi)	0.145

Conversion Factors for Measurements in Ontario Geological Survey Publications

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI unit	*Multiplied by*	*Gives*	*Imperial unit*	*Multiplied by*	*Gives*

LENGTH

SI unit	*Multiplied by*	*Gives*	*Imperial unit*	*Multiplied by*	*Gives*
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	**20.116 8**	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km

AREA

SI unit	*Multiplied by*	*Gives*	*Imperial unit*	*Multiplied by*	*Gives*
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha

VOLUME

SI unit	*Multiplied by*	*Gives*	*Imperial unit*	*Multiplied by*	*Gives*
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3

CAPACITY

SI unit	*Multiplied by*	*Gives*	*Imperial unit*	*Multiplied by*	*Gives*
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L

MASS

SI unit	*Multiplied by*	*Gives*	*Imperial unit*	*Multiplied by*	*Gives*
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1 016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t

CONCENTRATION

SI unit	*Multiplied by*	*Gives*	*Imperial unit*	*Multiplied by*	*Gives*
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy per ton) (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

***Note:** Conversion factors that are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.*